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EDUCATIONAL RECONSTRUCTION (4)

ADULT EDUCATION

ONE section of the White Paper on Educational Reconstruction, even at this stage, has caused considerable disquiet. That is the portion dealing with adult education. While the White Paper tells us that "without provision for adult education, the national system must be incomplete", there are few indications to show that the Government has any ordered policy for adult education. One cannot avoid the feeling that the paragraphs on adult education have been inserted diplomatically in order to assuage potential critics. There is little doubt, however, that it has had the opposite effect, and the concerted powers of adult educationists are being mobilized to persuade the Government to reconsider its attitude. That they will need as much support as possible may be deduced from the significant fact that in his amplifying statement when the White Paper was presented to Parliament on July 29, the President of the Board of Education made no specific reference to adult education.

To-day, some 80 per cent of the population of Britain left, or are leaving, school at fourteen years of age. That can scarcely provide adequate equipment for the citizens of a democracy ; and even this contracted education has in many cases been badly interrupted by the War. Yet these boys and girls who have left school at fourteen will be the majority of the electorate during the next thirty years ; the twenty-two million people who are already adult will decide the success or failure of the post-war social order. The educational provisions made for them may be indirectly the dominant factor in building the new educational order for children and young people adumbrated in the other parts of the White Paper. Yet the total additional expenditure which the Board is prepared to make during the first eight and a half years after the end of the War on technical *and* adult education is less than two and a half million pounds. No indication is given how much of this will be available for adult education alone. "Although the development of technical and adult education is not included among the matters to be dealt with in the first four-year plan, some allowance has been made for preliminary expenditure in respect of technical education." This can scarcely be said to be in tune with the high-sounding phrases in the White Paper about the value of adult education.

It must be brought home to Parliament before the Education Bill is discussed in the coming months that to neglect the education of adults will constitute an omission difficult to correct at a later date and one which will have profound significance in establishing a settled peace. The White Paper states that "it is only when the pupil or student reaches maturer years that he will have served an apprenticeship in the affairs of life sufficient to enable him fully to fit himself for service to the community. It is thus within the wider sphere of adult education that an

ultimate training in democratic citizenship must be sought". Democracy and education go hand-in-hand, and a belief in one implies a belief in the other. This truism has been so frequently stated that one is inclined to repeat it mechanically, and the pregnant meaning it contains passes unnoticed.

The case for the democratic faith has recently been skilfully presented by the Sub-Warden of Wadham College. The simplest description of democracy, Mr. Leonard says, tells us that it means government by the process of "counting heads instead of breaking them". A democratic outlook acknowledges that reason and not passion is the light which should illumine the pathways of human progress. It maintains that men, for all their faults and failings, are in fact sufficiently reasonable and sufficiently sociable to make it possible for great States to be ruled by those peaceful and reasonable means which we call parliamentary government. The subjects of a State form one people and should share in its government; no minority must be outlawed or outraged; minorities can accept the decisions of a majority because the majority will treat them with consideration and not drive them into disloyalty.

If we accept this as a reasonable description of democracy, we can see that there is an inviolate connexion between democracy and education, and particularly adult education. Using the methods of argument and reason, and requiring a consideration of minorities such as men will show only if they can understand and appreciate points of view which are opposed to their own, democracy needs an educated people, and cannot develop to maturity until a truly educated outlook is more general than it has ever been in human history. (It is not inappropriate here to recall that the cleavage between democratic and totalitarian States broke up the international relationships of scientific men long before most people believed that it must inevitably end in war.) While it is true that real adult education can only thrive in democratic soil, one must realize, too, to change the metaphor, that the sounding-board of a democracy is the quality of its adult education.

All modern States, whatever their form of government, must strive to maintain and improve the level of scientific and technical knowledge. Only in a democracy will there be a concern for the free development of cultural standards through ample provision for adult education. With trepidation one considers the prospects for democracy in Great Britain during the next 20–30 years if no more attention is paid to adult education than is indicated in the White Paper.

Adult education should aim at building up the resistances of people against the powerful influences of propaganda and advertising, and here training in scientific method would be invaluable. The ability to view facts objectively, to form judgments without reference to what one desires (or fears) to find, or to any kind of personal valuation, has taken centuries of mental discipline to achieve and has become one of the basic factors in Western civilization. It is a method which needs more and more adherents, and these are only likely to be found if increased attention is paid to the education of students of mature years.

It has already been pointed out that adult education has striven almost alone to remedy for hundreds of thousands the deficiencies of an educational system which ended for them on their fourteenth birthday. Adult education has also had tremendous influence in creating a public will calling for wider and wider educational facilities for the new generation. It has also left its imprint on the universities, and indeed rescued some of their members from the danger and unreality of academic aloofness. Further, through adult education, the teacher has been saved from the exclusive role of instructor, which must inevitably leave a mark on his own character, and has often been placed in the position of a leader of discussion in which direct interchange of views occurs.

What can be done to cater for those who have already left school or will leave school during the 20–25 years before the other proposals in the White Paper begin to take effect? Does the Government fully understand how much life in the Services has contributed to adult education, and what fertile soil awaits the implanting of its seeds? Have they realized that Service life itself is a powerful addition to one's knowledge of the art of living, and that the communal life of a barrack-room or mess is a sharp educational corrective to one's own experience of the place of individuals in society.

Everyone in the Services is familiar with the numberless 'courses', and few people will not have been sent away at short notice to be given a period of instruction at a centre where living in community is the usual and accepted method. In the Royal Air Force these courses have often meant residence abroad, while both the Royal Air Force and the Royal Navy are to-day sending men to the universities for six-month courses, during which time they live and study as ordinary undergraduates. It is worth noting that about half these airmen and sailors are taking courses in humane subjects—history, economics, philosophy, etc.—which can serve no immediate utilitarian or vocational ends. Thousands of men and women have passed through Ministry of Labour training centres and many thousands have taken part in residential courses for youth leadership, some of them lasting so long as thirteen weeks.

Besides all this there are the educational schemes of the Services, which have become the greatest development in adult education we have yet seen*. Much of this work is carried on within the units, but a great deal of it takes place during periods when Service men and women go into residence at the universities for periods varying between a few days and three weeks. The majority of these courses have been framed to make the students more aware of their responsibilities as citizens. Can we afford to let this highly important field of work remain uncultivated at the close of hostilities? What can be done in war should not be impossible in peace.

For all people, life is only beginning at eighteen.

*NATURE, 151, 438 (1943).

and for most of them it is after this age that interest awakens in the deeper issues of politics, morals, science, religion and so on. The Scandinavian countries have recognized this and have provided some two hundred adult education colleges for their sixteen million inhabitants. In Great Britain, to which the oppressed and subjugated peoples of the Continent and elsewhere will look for a strong and inspiring lead in the post-war world, there are nine residential colleges, of which seven are grant-aided. The total number of students in residence in these grant-aided colleges is about three hundred.

The case for residential education has been well put in recent publications of the Educational Settlements Association and is admitted to be desirable in the White Paper. The value of uninterrupted study in congenial and agreeable surroundings, undisturbed by vocational, domestic or other preoccupations, will be evident to all who have had to grapple with the limitations of evening classes. There is the additional stimulus of sharing the pursuit of knowledge for cultural ends in community with other students of like mind and interests; the merits cannot be stressed too highly. It presents a training in democratic living which would be difficult to get by any other means, while the recuperative and recreative effect of a period of withdrawal from the stress and strain of everyday life and employment is too well known to need amplification. This suggestion has received considerable backing from the Trades Union Congress. "The most serious consideration ought to be given to the possibility of instituting in this country a system of short-term residential study for adults. The Government should give a lead to employers to release workers for this kind of short course, with an assurance of reinstatement on their return." Residential colleges of diverse types that are already in existence in Great Britain have demonstrated the potentialities of full-time study in residence and indicated the latent demand. If the Government intends the reference to residential colleges in the White Paper to stand for something more than a political sop to their protagonists, it will have to provide for the purpose something more concrete than the financial proposals set out therein.

In addition to residential colleges for full-time education, there will be needed many non-residential institutions for part-time or leisure study. This is advocated in the White Paper. "There will need to be developed appropriate centres, which will not only provide the educational courses which the adult population may need, but will add to them the values associated with the life of a corporate institution". These should offer a suitable environment for the individual and social development of adults. The smaller citizen centres, of which Sir Richard Livingstone has been a leading advocate, would be admirable for the purpose until the larger all-embracing community centres could be provided. Citizen centres would be modelled on the lines of the educational settlements, of which there are nearly thirty in Great Britain at present. These provide a building which serves as a common hearth and home for all grades of students and other people engaged in social and educational activities in the neighbourhood. The citizen centre has much to offer to the development of adult education, and its place in the national system of education is one that needs earnest consideration.

For whom should adult education cater? There are those who say that we should not in any way pander to people who can only be attracted by the superficial and meretricious, and that we should cater only for students of good intention*. Yet with all the powerful resources at their disposal, the voluntary organizations connected with adult education before the War could do no better than enlist 3 per cent of the possible field of recruitment. It is unfortunate that their admittedly wide experience has led some of the voluntary organizations to believe that they hold a vested interest in adult education and that theirs is the only adequate method of diffusing culture to adults. One is not unmindful of the great danger of promoting a semi-education which might become superficial and dilettante, but methods of 'popularization' will have to be extended if we are to draw a near maximum number of students into the world of more serious pursuits. It would be a pretence to suggest that the work carried out in air-raid shelters by the Workers' Educational Association has been of a very formal nature, and yet it has made a notable contribution to the methods of providing educational opportunities for adults.

The experience of the voluntary organizations has shown that the effective demand for the more serious 'tutorial' classes is limited. The problem to-day is to provide for a wider constituency without diverting the serious student from the type of class from which he will gain most benefit. Both types of students will be catered for only if the two main principles of adult education survive—voluntary attendance and free discussion. Above all, one must remember that the most important influences brought to bear on the adult citizen are not through education in the narrow sense, whether formal or informal. The part played by the Press, radio, the film, pamphlets and books is beyond measure.

In industry, besides the education which can be called technical and which is designed exclusively as a means of training people for earning their living, much is being done to raise the cultural level of the masses. Many big industrial organizations, for example, provide lunch-hour programmes which are an attractive feature of the winter's educational programme. These have often been the means of stimulating a more serious interest in subjects for which formerly the individual had little concern. The educational organizers in industry have excellent opportunities for promoting educational work with adults, and it is encouraging to note that their numbers are increasing.

From the foregoing it can be seen that the main problems of adult education have yet to be resolved, and a tremendous volume of research needs to be undertaken. In a democracy, the utmost variety of

*NATURE, 152, 350 (1943).

educational activities is essential. Ideally, there should be a different educational provision for every student, and it is not beyond the bounds of possibility that one day this will be achieved. Meantime, it is hoped that the proposals made by the Board of Education to encourage educational institutions for research will be used to a considerable extent in the wide and exciting field of adult education. The White Paper suggests that a maximum of £100,000 a year should be spent on educational research. Compared with the amount spent at present, this appears to be a reasonable sum. When viewed against the human problems that need urgent investigation, it seems as inadequate as the other measures proposed for adult education in an otherwise well-designed White Paper.

INDUSTRY AND SOCIETY (2)

RELATION TO GOVERNMENT

THAT there must be some measure of public control of industry is not now seriously disputed. It is accepted explicitly by Mr. Samuel Courtauld in his valuable paper "Government and Industry: their Future Relations", and also in the Unilever Paper on unemployment, which, however, points out that this does not necessarily imply direct control, since the Government already possesses powerful indirect means of control. Production must be adjusted to human needs, not human needs to production, as has too often happened when industry has lost sight of the essential purpose of economic activity. Fundamentally, it might be said that government intervention in industry should be no more than to ensure that economic aims are subordinate to wider social purposes, and to create the conditions in which the desire to make industry a form of essential social service can best develop. It is not a question of size but of direction and fitness for the purpose. The big business may, as Lord McGowan points out, be essential for some purposes; for others the small unit may best serve our end.

When we come to the methods by which that public control is to be effected we have already a wealth of experience on which to call. Of this Madge's book gives an admirably concise survey, if necessarily much less comprehensive than is given in the two chapters on British experience in the regulation of business in Cushman's "The Independent Regulatory Commissions". The question is whether with all this wealth of experience we can agree to think together, as Dr. Barker says, about a solution of economic problems which agrees with the logic and character of our democratic community.

The amount of common ground in the numerous statements and reports which have appeared on this question of government and industry give real reason for hope of a solution by the democratic process of discussion and compromise, provided the issues are clearly seen and the fundamental principles applied to test the soundness of each solution proposed for a particular problem or industry. Here once again Dr. Barker is an invaluable guide. The issues of common life, he reminds us, do not exist in themselves or in things which can be done and then put away. They exist in persons, and are rooted and grounded in opinions and feelings. The reorganization of industry is really the reorganization of human beings, the redirection of their opinions and feelings. The action of government is fundamentally a psychological readjustment of the opinions and sentiments of human subjects, and no government can deal promptly and successfully with these real issues unless it knows at first hand the opinions and sentiments which constitute the core of those issues, and unless it periodically renews its knowledge to meet the constant renewal of these opinions and sentiments. That is the fundamental justification of the democratic process, and the reason for believing with Dr. Barker that the defects of business enterprise are due to the absence or imperfect development of the methods of open discussion and voluntary agreement which have been so highly developed in the State.

While there is no escape from the necessity of planning in the field of economics, planning enhances the importance of a democratic system of government. It is the essential corrective if human values and a sense of perspective are to be preserved, and in itself prevents planning going to the extreme limits seen in the totalitarian regime. Prof. Zweig, in his book "The Planning of Free Societies", notes that all planned economies have so far failed in practice to establish a real and successful self-government. His appreciation of the work of the Tennessee Valley Authority and analysis of the causes of the failure of the American experiment in the self-government of industry under the New Deal are as pertinent in this connexion as his final review of the conditions for the proper working of planning.

Planning is not a franchise or immunity which lies outside the jurisdiction of free discussion and voluntary compromise. It requires efficient preparation by research and investigation. Its objectives should be limited and clearly defined, for it is a powerful implement which should be used with the greatest care and foresight and applied only so far as is necessary; its abuse may easily destroy the most precious values. To employ the minimum measure of control to achieve a given objective should be the supreme aim, and therefore planning should be restricted to general control.

As Dr. Barker points out, if the State itself forms economic organs such as an Economic Council or a Council for Industry, it does so to facilitate the reconciliation and adjustment of claims and counter-claims prior to the action of the State, to promote the self-planning and self-discipline which are also integral to the economic system, and to achieve fuller and more informed discussion; and not to devolve upon them the burden of decision. When the leaders, directors and experts in the various economic fields are encouraged to do the work of self-planning, that

work is not remitted to their unfettered discretion. The democratic State does not release economic self-planning and self-government from their necessary immersion in the general and total flood of political self-government. All economic planning must be compatible with the liberty of a general society of free minds, and statesmanship must ensure that short-term planning is restricted to its own proper issues and the long-term mode of planning, with its restraints on the distant future, reserved for the great issues which demand its operation.

These considerations suggest that the question of the relations of government and industry is really one of developing good tools of procedure and using them well. Fortunately we may read much encouragement in this respect in the Nuffield College Statement on "Industry and Education" and in Mr. Madge's survey, "Industry after the War". It is implicit in the distinction drawn between three main classes of industry and enterprise that we should choose the tools appropriate to the particular task. First, there are the key enterprises such as the basic utility and transport services. Secondly come major industries occupying vital positions in the nation's economy and apt to fall under monopolistic or semi-monopolistic control, and thirdly there are industries of smaller or medium size to which these conditions do not apply.

For the first there is general agreement that the appropriate form of control is a public corporation, combining a high degree of independence in operation with the necessary safeguarding of the public interest by remote public control. Such control may vary widely in type, and each key industry will require treatment appropriate to its special operational conditions. While the only extension proposed by the Nuffield College Statement for the public corporation is that of transport, it is made clear that the principle is capable of further application, and a timely warning is uttered against the danger, in establishing new forms of industrial organization, of treating as static a fluid situation. Every care must be taken to avoid impeding structural change due to the development of new techniques, or to give a group of producers any vested right to impede the growth of new processes either within the industry itself or outside.

For the second main group of industries the statement proposes the establishment of industrial boards. These would be statutory bodies presided over by chairmen appointed and paid by the State. These boards would be responsible, in consultation with the economic organs of the government, for the formulation of general economic policy for the industries concerned, interpreting the State's requirements to the industry, and the requirements of industry to the State. Consisting mainly of representatives of the industry, including those of labour, they are conceived as a measure of industrial self-government which will promote efficiency while safeguarding public interest, in particular against monopoly. They aim at throwing on industry the responsibility for conducting its own affairs under adequate safeguards for the public interest.

These proposals would go far to meet the dangers to which attention has been increasingly directed of late. They bear some resemblance to the tribunals proposed in 1919 by the Report on Trusts, when the public interest is adversely affected by monopolist organization. The statement is even more explicit on this point in a further section. It advocates dealing drastically with forms of profit-maintenance which result in the indefinite survival of inefficient producers, as well as in unduly high profits for the more efficient. The inefficient producer, unless he is made efficient, must go, subject only to the need for spreading the disappearance of uneconomic enterprise over a period long enough to avoid serious hardships or widespread unemployment.

There are other suggestions with regard to machinery of government in the Nuffield College statement which deserve note. The importance of substantial changes in the recruitment and organization of the public services and in the methods of industrial administration is stressed. Apart from the development of a technique of control and administration which will be effective and reasonably simple both from the point of view of the business man and of the Civil Service, it will in effect be necessary to develop a kind of public administration to deal with the State's new and expanding functions in the industrial field. This in turn involves recruiting new types of men and women, and once again we find emphasized the importance of closer assimilation between the rates of salary paid in public and in private business, of encouraging freedom of movement between publicly and privately administered concerns, of ensuring that technical as well as administrative ability is given the fullest recognition and scope, and of attention to the right training of those who are to enter the service of industry and commerce.

Further, public enterprises, urges the statement, should be so managed as to cover costs, including a reasonable return on their real capital assets, and where any element of subsidy is deemed necessary in the public interest, it should be open and not concealed. To avoid undue rigidity the managerial and technical staffs of public industrial enterprises should not be called upon to work under Civil Service conditions or be given similar guarantees of permanence, although the arrangement of pensions schemes so as to facilitate migration into and out of the public services is advocated. Similarly, the highest administrative positions in all branches of the public industrial services should be effectively opened to all possessing the right personal and technical qualifications, and should neither be the preserve of a particular administrative class nor closed in practice to the best men by inferior standards of remuneration and conditions of employment. Once again we encounter the suggestion of the constitution of standing parliamentary committees as a means of making parliamentary supervision of economic policy more practical and effective, a suggestion which merits more solid reasons for negation than the Government has yet given in Parliament. The publication of informative accounts is only one of the further

measures which the statement suggests to encourage confidence in the integrity of industry and to overcome past prejudices.

The resemblance between this picture of the relations between government and industry and the practical target outlined by Mr. Madge is striking. Mr. Madge visualizes a Minister of Production, but with extended powers and functions more clearly defined, and assisted by both an executive staff, drawn largely from men with experience of the productive side of industry, and a research and advisory staff, to survey industrial problems and draft plans for their solution. Members of this section should not be permanent members of the Civil Service, but drawn from the ranks of management, the professions, the trade unions and the universities. Use would also be made of independent research work in the universities and elsewhere. A similar proposal has since been advanced in the report of the Sub-Committee of the Liberal Party.

Under this government machinery there would be three types of industrial organization, all of which would be given a fair chance to prove their worth: State-owned and State-managed; privately owned with some or all directors appointed by the State; and privately owned and privately managed. In some industries all three methods of control and management might be used experimentally; in others a whole sector would be State-owned or privately-owned. Provision would be made in all types for joint consultation with labour on labour questions and other matters both at the works and at the national level, and books and records should be open for inspection by the research and advisory section of the Ministry of Production, which would review the efficiency of these methods and make its findings public. It will be noted that Lord McGowan recently advocated a step in this direction in recommending the registration of every international trade agreement with the Board of Trade, so that the Government would possess a complete picture of British participation in cartels.

What is hopeful in this whole approach is the emphasis laid on co-operation and a new spirit in industry. Machinery, either in the mechanical sense or in that of organization, is not enough. True it is that there are severe limits to the extent to which industrial democracy is practicable. The number of those sufficiently interested, apart from the question of technical qualification, to take any continuously active part in the management of an industry and the determination of working methods and conditions is relatively small. But while it is important to do everything possible to provide outlets for originality, energy and organizing ability, and to imbue all members of an industry from its directorate downwards with the spirit of public service, it is important that the humblest workers should feel that they have the opportunity to rise higher according to their ability, that their treatment is fair, and that their work provides worth-while opportunities for human energy and skill. If we succeed in this, it will matter little to the workers in any industry that general policy and technical control must be ordered from above. Secure that policy and control are ordered in the general interest of the community, they will recognize that power as legitimate power, and find in their occupation once more the social satisfaction which is the basis of a functioning society.

It should be noted that the Nuffield College Statement looks to social security legislation on the lines of the Beveridge Report as providing a necessary foundation for better industrial relations as well as to this greater publicity, and its concluding emphasis on the key factor of management and the powerful reaction of the situation on the position of managers and technical staff will be noted by scientific workers.

The fuller recognition of industrial management as a skilled profession, requiring both high personal qualities of enterprise and imagination and appropriate forms of special training, should not only improve the technical efficiency of industry but also foster good relations among all who are partners in the work of production. Moreover, the more industry becomes a partnership of all grades and sections of those engaged in it, the greater become the demands upon its managers for skill in the democratic handling of men as well as in the technical sphere. But even the question of closer collaboration between industry and education is secondary to that of collaboration between industry and the consuming public, and between those responsible for the direction and management of industry and those they employ. All engaged in industry must put first in their relation to industry the aim of serving the public, so that no question of sectionalism or exploitation can arise to disturb the confidence and good relations existing between industry and the rest of the community.

CHEMICAL PHYSICS: THE COMMON THEORETICAL BACKBONE OF CHEMISTRY AND PHYSICS

Introduction to Chemical Physics

By Prof. J. C. Slater. (International Series in Physics.) Pp. xiv+521. (New York and London: McGraw-Hill Book Co. Inc., 1939.) 33*s*.

A WORD of apology is due to this book and its author for the delay in this review. The review copy was received by the reviewer just before he started for Canada on a liaison mission which lasted some ten months. On his return the book was overlooked until recently, when, during a prolonged period of leave, it was found and studied with avidity, and the writing of this notice at last undertaken. The book is excellent, and, no matter how great the unfortunate delay, deserves a proper notice in the columns of NATURE.

What precisely is 'chemical physics'? The author gives one answer in his preface which the reviewer willingly accepts. One may define, roughly, chemistry as the science of atoms and the way they combine, and physics as the science of interatomic forces and the large-scale properties of matter resulting from

those forces. One may even deplore, nowadays, that physics and chemistry were ever separated, though one must admit that prior to the developments of the last forty years such separation seemed natural and necessary. But the tendency both of theory and of experimental technique has been to emphasize the oneness of the science of the properties of matter, of which chemistry and physics are two most intimately linked branches, with a very wide range of study in common. To stress the importance of this common field in which both chemists and physicists must be trained, it is useful, and indeed essential, to have a name for it. An earlier attempt at a marriage of these two sciences gave rise to the name 'physical chemistry' for the range of study then contemplated as a common range. This name, otherwise suitable, cannot therefore well be used to describe the very wide common field of the united chemistry and physics of to-day. Physical chemistry has flourished in the meantime and acquired a significance of its own as the study of a limited common ground of chemistry and physics, covering such subjects as the applications of thermodynamics and kinetic theory to the properties of gases, liquids and (particularly) solutions—no attempt has been made to be exhaustive. Since physical chemistry is pre-empted, and for want of a better, the author proposes the name 'chemical physics' for the widest possible range of studies common to both chemistry and physics that it is possible to contemplate to-day.

Defined in this way, chemical physics really covers all theory of and experiments for the properties of matter, for which the atomic or molecular structure of matter is relevant, both in equilibrium and non-equilibrium states. Such a study could only be fully covered in many large volumes. What is attempted here is less ambitious and far more useful. It is to present the elements of chemical physics in a way that demands the minimum of mathematical technique from the reader, and, as the reader will frequently be a chemist, in a way that is intelligible without much previous study of theoretical physics. Thermodynamics, statistical mechanics and kinetic theory form, of course, a vital part of the subject, and are given in Part 1 of the book. They are the essential link between the properties of atoms and molecules given by the quantum theory and the properties of matter in bulk. They are presented throughout in a form that has been chosen for reasons of simplicity and freedom from mathematical difficulties rather than logical beauty, and on this score little exception can be taken to the author's choice. For the non-mathematically minded physicist, and above all chemist, it will give an entirely admirable training in this fundamental part of chemical physics, and for the mathematically somewhat more ambitious an equally admirable introduction. It provides a course of study suitable for a Part 2 Tripos student in physics or in chemistry with any aptitude at all for formal mathematical theory.

Having covered the vital "Thermodynamic" ground in Part 1, Dr. Slater proceeds in Part 2 to apply the theoretical techniques just introduced to the various states of matter and phase equilibria. This part proceeds on well-established lines and is an excellent elementary account of this part of the subject, the needs of the same type of student being borne in mind throughout. The most interesting novel features of this part of the book—novel, that is, for such an elementary treatise—are the careful elementary discussion of melting and of the entropy difference between a liquid and a crystalline phase of a simple substance in Chapter 16; a discussion of phase equilibrium in binary systems covering the liquidus and solidus curves of a binary metallic alloy and the complete phase diagram for the mixtures copper–magnesium and copper–zinc, designed to whet the appetite of the budding metallurgist, in Chapter 17; and phase changes of the second order with special reference to order-disorder transitions in copper–zinc systems in Chapter 18—the whole expounded with elegant simplicity.

In Part 3, Dr. Slater passes on to the other main branch of the subject, atoms, molecules and the structure of crystals, in which thermodynamics plays a minor part, as most of the structures concerned are predominantly ordered at all temperatures, and the fundamental theoretical technique is that of the quantum theory. Thermodynamics survives in this part mainly in the theories of radiation (Chapter 19), thermionic emission and the Volta effect (Chapter 28) and the electron structure of metals (Chapter 29), where of course the photons and electrons still need statistical handling to give the properties of bulk matter. Here again the students' need for simplicity is carefully watched; *a priori* knowledge of the quantum theory beyond the barest outline is not essential to the reader. Results of the quantum theory are quoted and used mainly in a descriptive form, which the student of chemistry should be fully capable of following without study of their theoretical basis, unless he is interested to do so and willing and able to acquire the necessary mathematical technique. The outstanding feature of this part is provided by the three chapters (24–26) on homopolar bonds in inorganic molecules, organic molecules and the silicates respectively. Nothing but the simplest descriptive accounts of the simplest cases is of course attempted, in terms of shared electrons. The reader is told clearly where difficulty arises, as in the benzene ring. Nothing much more is possible without a here unwarrantable dive into the quantum theory of resonance. The bare statement, however, that the quantum theory accounts perfectly satisfactorily for these apparent difficulties of the shared electron picture might perhaps be backed up by suitable references, making an exception for once, in view of its importance, to the author's no-reference policy. The book would be improved thereby. Nor is the printing too happy in these chapters. The double dot notation of G. N. Lewis for the pair of shared electrons is admittedly very difficult to lay out for the printer for any but the simplest molecules. The reviewer would like to see even more of the structural formulæ not laid out in type, but drawn and reproduced from small blocks set in the text—an expensive method but amply justified by the added clarity it would give in this important part of this valuable text-book.

Teachers and students alike of elementary chemical physics, the wide field of theory which is rapidly unifying chemistry and physics into a single science (or at least into two close-knit branches of a single science), owe Dr. Slater a profound debt of gratitude for this book. It was a book that badly needed writing. The temptations along the author's path to indulge in too advanced ramifications have been nobly resisted. Only those who have planned and failed to write an elementary book in this field will appreciate fully the devastating difficulty of this success.

R. H. FOWLER.

HISTORICAL PLANT GEOGRAPHY

An Introduction to Historical Plant Geography

By E. V. Wulff. Authorized translation by Elizabeth Brissenden. (A New Series of Plant Science Books, Vol. 10.) Pp. xvi+224. (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1943.) 4.75 dollars.

THE study of the areal distribution of plant species, genera, and families is what is generally understood in Great Britain by 'plant geography' or 'phytogeography', as distinct from the wider field of 'plant ecology'. It is in this sense that Prof. Wulff employs the term in the title of his book which, however, is expanded to "Historical Plant Geography" (without altering what we should regard as the proper content of a phytogeographic text) in order to convey the emphasis required by the author's outlook: "Historical plant geography has as its aim the study of the distribution of species of plants now existing and, on the basis of their present and past areas, the elucidation of the origin and history of development of floras, which, in turn, gives us a key to an understanding of the earth's history".

No branch of science could, more than this, need the fullest and most unreserved international co-operation, and it is a welcome sign that it should have been possible during war-time to get the work of a distinguished Russian botanist translated into English, and that this work should have been published through the activities of an enlightened Dutch *émigré* organizing botanical publications in the United States. British workers have in the past contributed much to the foundations of this subject, as can be shown by the mere mention of the names of Lyell, Forbes, J. D. Hooker, Darwin, Wallace, Willis, Ridley and Guppy. Nevertheless, it cannot be denied that in recent years it has lost much of its attractiveness as a subject of research to British botanists, probably in part because of a rather nebulous character consequent on its lack of exactitude and experimental techniques in comparison with other aspects of botanical investigation.

The subject, all the same, has moved steadily forward, and a considerable bulk of work done by Continental, and especially by Russian, phytogeographers is in this book made available to English-speaking botanists, while a very concise foreword by Hugh M. Raup makes a most helpful survey of the very significant American literature which has appeared on the subject in the last few years. The present volume is the first of three by Prof. Wulff and comprises a general and theoretical treatment of the principles of plant geography; the second, already written, is a "History of the Floras of the World", and the third, in preparation, deals with the changes in floras caused by man's activities. We hope that in due time all three volumes will appear in English, but meanwhile the first of them is most opportune. This is particularly so since the last few years have furnished to the phytogeographer such valuable new tools and so much fresh evidence, that a phase of expansion of the subject clearly lies ahead. Of this our botanical students are vaguely or not at all aware, and this first English text to reveal the new potentialities must therefore be valuable and welcome.

We can best convey the content of the book by the chapter headings: (1) historical plant geography: scope, relation to allied sciences, methods of investigation; (2) history of the science; (3) areas, their centres and boundaries; (4) the origin of areas; (5) types of areas; (6) parallelism in the geographical distribution of plants and animals and correlation between the distribution of parasites and that of their host-plants; (7) artificial factors in the geographical distribution of plants; (8) natural factors in the geographical distribution of plants; (9) the migrations of species and floras and their causes; (10) historical causes for the present structure of areas and the composition of floras; (11) concept of floral elements.

Though impartially surveying the subject as a whole, Dr. Wulff emphasizes throughout his own attitude, that the primary object of the study is the revelation of the history and of the mechanisms by which present areal distributions were achieved. He stresses that we must bring to this study every scrap of relevant evidence of fossil plants—"the importance of such data should not be underestimated, since they constitute the only direct evidence available for establishing the history of a flora". This attitude also involves the recognition of the results of pollen analysis and other studies bearing directly upon the history of vegetational migration and equally upon palæoclimatology. Dr. Wulff assigns very great importance to large climatic changes in altering the geographical range of plants. He insists also that "Biogeographical conclusions only find definite confirmation, when it is possible to base them on a geological foundation. . . ." The search for such foundations leads the author to consideration of the alternative hypotheses of submerged continents, sunken land-bridges, and continental drift, as bases for explanation of present and past plant distribution. He considers that the phytogeographic data decisively support the latter type of explanation despite the present inadequacy of the Wegener hypothesis for the Pacific region. It is interesting to find that so experienced a phytogeographer considers the influence of man to have been relatively unimportant, and he agrees with Willis in stressing the inability of introduced species to spread into undisturbed natural communities. Indeed, it is suggested that both cultivated plants and their associated weeds have lost many of the adaptive mechanisms needful for such expansion. Slowness of natural distribution is also emphasized: "Plants are dispersed as a result of the transport of their seeds by natural means only slowly and gradually, gaining new territory step by step". There is no strong preference for one school of thought as against another, a broad objective width of approach characterizing the whole book, the author, for example, accepting and explaining relic distribution areas with the same clarity and fairness that he gives to the patterns formed by the expanding groups where new species are being created.

Dr. Wulff rejects no type of evidence bearing on the history of floras: study of the characters of the distribution areas themselves, critical taxonomic and morphological investigations of the group concerned, the modern cytogenetical evidence, ecological adjustment of the species, the effectiveness of dispersal mechanisms, the nature and distribution of plant parasites and hosts, all are laid under contribution, as is indeed logical and inevitable. That the results are not always clear and beyond question is due to the sparsity of available data. Dr. Wulff has shown from how wide a field such evidence must come, and on how wide a front advance in this subject is now recommencing.

H. GODWIN.

The Royal Institution

By Thomas Martin. (Science in Britain Series: Published for the British Council.) Pp. iv+46+4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1942.) 1*s.* net.

BEHIND its imposing Georgian front, the Royal Institution in Albemarle Street, London, conceals well-equipped laboratories fitted up for research in the physical sciences, a comprehensive library of general as well as scientific interest and a lecture theatre with all the aids that modern science has provided for the use of the lecturer. It was founded by Count Rumford, that remarkable genius who combined politics with philanthropy and both with science. Rumford, who was born in Massachusetts, New England, of a family of English descent, had held the post of under-secretary in the Colonial Office in London, and later had taken office under the Elector of Bavaria, in whose service he returned to London in 1798. He decided to remain in London, and in 1799, with Rumford as the prime mover, the Royal Institution was constituted, "for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life".

Mr. Thomas Martin has been general secretary of the Royal Institution since 1929 and knows its history intimately. In the present booklet he outlines the inception of the Institution and skilfully sketches the many scientific developments with which it has been associated through its distinguished line of professors and directors, from Rumford himself, through Davy, Faraday, Tyndall, Dewar and Sir William Bragg. Mr. Martin has accomplished the difficult task of compressing a story full of interest into a brief but fascinating booklet.

Diseases of Vegetables

By Donald E. Green. Pp. vii+208. (London: Macmillan and Co., Ltd., 1943.) 8*s.* 6*d.* net.

IN the monthly issues of the *Journal of the Royal Horticultural Society*, January 1941–April 1942, there appeared a series of excellent papers by Mr. Green entitled "Hygiene in the War-time Vegetable Garden". These have now been brought together, revised and expanded to form the present book, which gives in brief but adequate form for market gardeners and amateur growers of vegetables information concerning the recognition and treatment of diseases of their crops, illustrated by a very rogues' gallery of excellent portraits of diseased plants.

Only one who has had much first-hand experience of diseased plants could write with so much practical insight as this book possesses, and only one knowing his growers intimately could have sensed and met their needs so well. Especially will all growers welcome the admirable "Key to Disease Symptoms" with which the book opens and the clear recommendations of practical measures of control with which it ends. The author is described on the title page as "Mycologist to the Royal Horticultural Society", but his book includes, in addition to the fungal diseases of vegetables, those caused by bacteria, viruses, and the various non-parasitic agencies such as unfavourable conditions of soil or cultural treatment.

The text is written in a simple but, at times, repetitive and wordy style with occasional sentences, statements, or omissions which might with advantage be reconsidered when a second edition is called for. For its price the book is most agreeably produced, and it should serve the needs not only of professional market gardeners but also of the multitude of amateur war-time growers who are apt to feel distressed and very helpless when faced with unexpected and strange lapses in behaviour on the part of their allotment vegetables.

Statistical Tables

For Biological, Agricultural and Medical Research. By Prof. Ronald A. Fisher and Dr. Frank Yates. Second edition, revised and enlarged. Pp. viii+98. (London and Edinburgh: Oliver and Boyd, 1943.) 13*s.* 6*d.* net.

THESE tables, first issued in 1938, were early recognized as an authoritative production in the domain of statistics as applied to biology. The main modern tests of significance, many the work of the authors, are covered; the introduction is a mine of knowledge in itself, and the tables cover all the contingencies envisaged.

This edition, which maintains the standard of the first even to the quality of paper used—no small achievement these days—incorporates new features. Additional tables are provided for precise testing of the significance of the difference between sample means when it is not valid to pool the estimates of variance. One essentially practical problem can thus be dealt with, namely, the comparison of estimates of a physical constant, one based on numerous data of low precision, the other on a small quantity of precise observations. An extra table provides the limits of expectation for the probability of an event observed to occur a number of times in a series of trials, and thus supplies a more direct solution than hitherto of another practical problem. The densities of organisms estimated by the dilution method can be easily calculated from a new table.

The complex subject of balanced incomplete block arrangements, used in field trials, involves the tabulation of combinatorial solutions, which have been simplified by the more extensive use of solutions of the cyclic type. A new type of square arrangement is described in the introduction.

The value of the volume is enhanced by the worked examples illustrating the use of the tables.

J. WISHART.

Practical Physics

By Prof. Marsh W. White, Dr. Kenneth V. Manning, Prof. Robert L. Weber, Dr. R. Orin Cornett, and others on the Physics Extension Staff. (Pennsylvania State College Industrial Series.) (Prepared under the direction of the Division of Arts and Science Extension, the Pennsylvania State College.) Pp. x+365. (New York and London: McGraw-Hill Book Co., Inc., 1943.) 2.50 dollars.

THIS course of study, which is stated to have been tried out on a large scale in Pennsylvania during the War, resembles both in scope and quality some of those devised for evening classes in physics that are customary in Britain for engineers attending National Certificate courses. The emphasis is on mechanics, heat, and current electricity; less attention is given to sound and light. Each chapter reads like the record of a lecture, enlivened by popular illustrations and numerical examples, and followed by a simple experiment, performed either by the

lecturer or by a group of students. Unlike several British books having similar titles, this is not a guide to precise experimental technique. The word "practical" in the title may perhaps be justified by saying that the lectures were designed to suit "practical men" in the sense of people of *I.Q.* about 120, who are familiar with tools, who have scant time for study, and who may be tired after a day's toil. Theory, such as occurs in first-year university courses, is here cut out as much as possible: there remains a little algebra and trigonometry, but no calculus. For example, a chapter on uniform circular motion begins with pictures of machines, states the formula for centripetal force without proof, and explains carefully its general interpretation and briefly its applications to aviation, to cream separators and to banked roadways. The chapter then offers a set of numerical examples, and ends with an experiment in which a girl student is shown holding a vertical glass tube through which passes a string, attached below to a weight, and above to a mass which she whirls in a horizontal circle. A blank form is provided for the observations and deductions.

Protest must be made against the reappearance (on p. 56) of the old fallacy that the time taken for a rise of temperature to move along a metal bar depends only on its conductance; whereas, in fact, its specific heat and density are just as essential.

Honours graduates in physics, who are about to begin to lecture in National Certificate courses, would find in this book a guide to what is possible in those circumstances.

L. F. RICHARDSON.

Recent Advances in Galactic Dynamics

By Prof. A. C. Banerji. (Lucknow University Studies, No. 15.) Pp. vi+116. (Lucknow: Lucknow University, 1942.)

THE author of this book was invited to give three extension lectures at the University of Lucknow in 1940 on galactic dynamics, and they have now been published in the form of a monograph. The first lecture deals with polytropic configurations of rotating gaseous matter, and provides an excellent summary of the work of investigators from the earliest times up to the present. It ends with a brief discussion of the numerical solution of the differential equations which occur in the cases of polytropic configurations of rotating gases. The second lecture summarizes the investigations of Hubble, Jeans, Brown, Vogt and Lambrecht, Lindblad, and a number of Indian workers, including the author, on spiral nebulæ. A full account of the researches of Indian workers has appeared (*Phil. Mag.*, 7, 28, 118; 1939), and also in a number of Indian publications of more recent date. The origin of the solar system is considered in the third lecture, and the various theories to explain it are dealt with, from Swedenborg and Kant's nebular hypothesis to the recent theory of Lyttleton that the sun was a binary, its companion being disrupted by a passing star, the planets and satellites being formed from the debris. The investigations of Bhatnagar are considered and these have an important bearing on certain problems connected with planetary formation. He has shown that there is no possibility of the formation of the ribbon, from which the planets were supposed to be formed, by a close encounter or even a grazing collision between stars of normal masses. In addition, he has shown that the origin of the solar system is inexplicable by any existing tidal theory.

This is an excellent summary of our knowledge of stellar dynamics, and its value is enhanced by the references to all the workers on this subject.

M. D.

Intermediate Qualitative Analysis (Inorganic)

By Dr. A. J. E. Welch. Pp. iv+154. (London: University Tutorial Press, Ltd., 1943.) 3*s.* 9*d.*

THIS book provides theoretical and practical instructions for the qualitative analysis of mixtures, and can be recommended for the use of students at the Intermediate and Higher Certificate stage.

An outline of the theoretical principles underlying qualitative analysis is given first of all, and, apart from the use of the obsolete ferric-thiocyanate equation for the illustration of the law of mass action, it is quite adequate. There then follows an excellent chapter on the preliminary tests, apparatus and experimental technique of analysis. Especially clear instructions are given on the use of the blowpipe, platinum wire, etc., in the dry tests which are so frequently bungled by inexperienced students.

The reactions for the identification of metallic radicals are described in sufficient detail, but it is a great pity that they have been represented throughout by molecular equations and the opportunity thereby lost of emphasizing the ionic character of most of them. The tests for acid radicals have been arranged in a system of three groups which should be easy to operate.

In the closing chapter the tests are summarized in a tabular form which should prove useful, especially as the correct quantities of the reagents have been specified.

A. C. C.

A New German-English Psycho-Analytical Vocabulary

By Alix Strachey. (Research Supplements to the International Journal of Psycho-Analysis, No. 1: Published for the Institute of Psycho-Analysis.) Pp. v+84. (London: Baillière, Tindall and Cox, 1943.) 10*s.* 6*d.* net.

DICTIONARIES are of use to many and a source of real joy to a few. To this small minority the present slim volume will prove additionally attractive through its excellent typography. It is, as the preface states, essentially an enlarged and revised edition of a glossary issued as a supplement to the *International Journal of Psycho-analysis* in 1924. It does not contain the interesting notes and comments appended to certain entries in the former work, but with the increasing standardization of psycho-analytic terminology in the intervening years these are now scarcely necessary. A good many terms that were being tentatively introduced at the earlier date have now been generally adopted; for example, 'parapraxis' and 'cathexis' (for *Fehlleistung* and *Besetzung* respectively). On the other hand, the word 'unpleasure' (for *Unlust*), formerly described as "hardly acceptable linguistically", is now accorded the dignity of a technical term. Those who grumble at the 'Freudian jargon' will probably express 'displeasure' at such terms as 'scopophilia' and 'osphresiophilia', but would they stomach 'peeping' and 'sniffing' any better? It is perhaps a pity that Havelock Ellis's more euphonious 'eonism' (on analogy with 'sadism' and 'masochism') is not given as an alternative to 'transvestitism'.

J. C. FLUGEL.

A HUNDRED YEARS OF ANTHROPOLOGY IN BRITAIN

By Sir JOHN MYRES, O.B.E., F.B.A.

THOUGH the Royal Anthropological Institute was not founded until 1871, it is the direct successor of the Ethnological Society of 1843, after amalgamation with the Anthropological Society of 1863, and may justly claim now to celebrate, on October 30, the centenary of the organized study of man in Great Britain; and the main turning-points in the careers of these Societies illustrate the general course of events in a wide range of studies, from comparative anatomy of the principal human varieties to comparative religion, sociology and linguistics, and the whole range of the material arts with their archæological perspective, so nearly co-extensive with human palæontology.

At first sight this study of man is no systematic science, like chemistry or physiology, but rather analogous to geology and geography, which combine the methods and the data of more specific branches of knowledge for the elucidation of problems of a secondary order, and especially involving relations of distribution in time and space. But it has been characteristic of British anthropology to insist that the peculiar nature of man provides the same kind of common basis and definition for a coherent mass of information, and systematic study of this material by every available means, as the earth provides in geography—and not least because in geography, too, it is 'the earth as the abode of man' which seems to many geographers to differentiate between this study and geology or terrestrial astronomy. American anthropology has followed the same line of thought and development; partly because in the New World, as in the British Empire, there has been so great a wealth of opportunity for the regional study of more or less self-contained and self-determined varieties of mankind, so that analytical studies of structure, language, material and social equipment have been continually challenged and tested by fresh discoveries in the field; whereas in most European countries, less well provided with 'aborigines', the special sciences which contribute to the study of man have developed independently, and lost this common basis of humanity. It is also this common objective, which has given to much British and American work a disciplinary and educational value, and thus has at long last determined the position and function of the principal anthropological institutions and schools, as the outline of an academic discipline which might claim in due time to be *Literae humanissimae*.

Though both physical anthropology and the elements of ethnology, and what is sometimes distinguished as cultural anthropology, had long been studied discursively, in classical culture, and from the Revival of Learning, there were many convergent instigations to more systematic treatment in the early years of the nineteenth century. The Romantic Movement, and the Revolutionary Movement which emerged from it, gave the same impulse to human studies as to the physical sciences. In both the cry was 'back to Nature', at whatever cost to convention or authority. Anatomical studies reformulated old problems of the origin and significance of human races and varieties. Comparative philology indicated processes of modification and replacement among languages, and relations of heredity between them, seductively like those of a pedigree, and sometimes correlated regionally with major racial types, Semitic with Arab, and the like. The Danish archæologists combined typological classification of implements—stone, bronze, and iron—with the stratigraphy of the peat bogs where they were found, and especially with secular changes of flora and climate. Cave-finds in France and in England associated rude implements with 'ante-diluvial' fauna, and even with human remains. Comparative mythology, in dangerous alliance with philology, led on to the interpretation of social and political terms in kindred languages, to a comparative sociology, and to a 'linguistic palæontology'. The common factor in all these new studies was the notion of development and series of events in time.

There were other considerations, more practical and controversial; the abolition of slavery was a corollary of the Rights of Man within one human species. But what if, zoologically, there was more than one human species, of separate special creation and independent 'place in Nature', like that of the domesticable animals, over whom human dominance seemed to have biblical sanction. Was not *black* man, in fact, the 'natural slave' as defined in Greek philosophy? To some, the American Indian seemed to present a similar problem, as the economic expansion of the West went on. On both sides zoological arguments were brought in, to support philanthropy or to challenge vested interests, and it was long before this kind of 'applied anthropology' became obsolete.

There was also the practical question: What was to be done with the 'black brother' after emancipation? Was he improvable into something not so far from white? What was the relation between physical and mental characters in man, and what could be done to perfect Nature's work by scientific processes? It is significant that most of the early British anthropologists were practising medical men, and James Cowley Prichard, the most eminent, was a Commissioner in Lunacy, with a high repute in questions of the moral and legal responsibility of the insane. Several were also members of the Society of Friends, and Thomas Hodgkin was the founder of the Aborigines' Protection Society in 1838. Other philanthropic agencies, the Negro Emancipation Society and the British Africa Colonization Society (both of 1834), collected information and used it as best they could. Another foster-parent, for obvious reasons, was the British Phrenological Society.

The earlier history of the Ethnological Society has been so fully told elsewhere that only essentials are necessary here. It was never a populous or influential body, and owed its existence and successes to a small group of original and devoted men, nearly all in professional careers, and very few of them affluent. On many occasions the same persons appear as the active members of the geographical or zoological section of the British Association, sometimes in a specific subsection for ethnology; and this summer and winter partnership, never quite effected in any other section, makes the origin of some enterprises difficult to trace, except personally.

In 1839 Prichard addressed to the British Association a warning, already needful, on "The Extinction of some Varieties of the Human Race", and appealed for prompt and organized effort to record this vanishing material. It was the first of a long series of such appeals, to forestall both the disappearance of aboriginal communities altogether, and the no less fatal effects on aboriginal customs, of contact with colonists, traders, and missionaries. For the guidance

of intending travellers and of observers already in contact with natives, the British Association appointed a committee to draft a pamphlet of "Instructions to Travellers", in which the whole programme of anthropological and ethnological research was set forth: an original and stimulating directory, and the immediate predecessor of the well-known "Notes and Queries in Anthropology" which have for many years been printed and reprinted by the British Association, but sold, and distributed to travellers, by the Anthropological Institute. It was the first example of a type of handbook of which the most famous is the Royal Geographical Society's "Hints to Travellers".

On June 22, 1842, Prichard again addressed the British Association "On the Relation of Ethnology to other Branches of Knowledge", with the outline of an inclusive programme of advanced study and objectives for research; and on July 20 the prospectus was issued for an Ethnological Society, signed by Richard King (1811–76), a pupil of Thomas Hodgkin at Guy's (M.R.C.S. 1832 and hon. M.D. of New York), who had been surgeon-naturalist to Capt. George Back's expedition to the Great Fish River (1833–35), and published a book on the Eskimo in 1844. The first meeting was held early in November, 1843, with King as secretary and Admiral Sir Charles Malcolm (1782–1851) as president. Malcolm had been superintendent of the Bombay Marine, the precursor of the Indian Navy; he had created a distinguished school of surveyors, and devoted much of his leisure to the Royal Geographical Society and to the organization of charities. Meetings were held in Hodgkin's house in Bedford Square, London, and in hired rooms at 27 Sackville Street, W., and both Hodgkin and Prichard seem to have been generous financially. The latter published his "Natural History of Man" in 1843, and died in office as president in 1848. Another good friend was James Crawfurd (1783–1868), who had used the opportunities of a medical career in India and Malaya and returned home in 1827 to devote himself to Oriental languages.

King returned to arctic exploration in 1850, wrote an inclusive account of the long search for Franklin (1855), published an account of the Lapps (1871), and lived to be a member of the first council of the Anthropological Institute.

Another pioneer, on rather different lines, was Robert Knox (1791–1862), who graduated in medicine at Edinburgh in 1814, served as army surgeon at Waterloo, studied in Paris under Cuvier (1769–1832) and Geoffroy E. Saint-Hilaire, and organized the Museum of the Royal College of Surgeons at Edinburgh (1825), collecting material under the adventurous conditions of the time. Passionate and heterodox, he gravely damaged his own prospects; he lectured volubly on the "Races of Man" in many places, and wrote copiously in the Press, rendering much erratic help to the Society, and became in 1860 an honorary fellow and honorary curator of its museum. He held strong polygenist views but deemed the origin of races to be beyond human inquiry. His influence, therefore, waned when Darwinian evolution was popularized.

Very different are two anthropological pioneers of the next decade. John Beddoe (1826–1911), of Bridgnorth, graduated in medicine from University College, London (1851), and studied in Vienna. Hospital service at Renkioi in the Crimean War extended his earlier studies of hair and eye colour (1846) to Mediterranean peoples, which he continued to observe in Bristol and Cardiff when he went into general practice. His massive material on "Stature and Bulk of Man in Great Britain and Ireland" (1870) and "The Races of Britain" (1885) has been supplemented but not replaced, especially by the British Association's Ethnological Survey Committee and Anthropometric Committee. He was an early and active fellow of the Ethnological Society and a foundation member of the Anthropological Society, and it was under his presidency of the latter (1869–71) that the schism was reconciled and the Anthropological Institute inaugurated.

George Rolleston (1829–81), combining classical scholarship with anatomical distinction, served, like Beddoe in the Crimean War, and as Linacre professor of zoology at Oxford amassed a valuable collection of crania, submitted his system of brain-classification to the British Association at Oxford (1860) and supported Huxley in opposition to Owen at Cambridge in 1862. His Royal Institution lecture (June 24, 1862) is another turning point. With William Greenwell ("British Barrows", 1877), he established the racial history of Britain on the same sure foundations as the racial distributions outlined statistically by Beddoe.

But the leading mind in ethnology during the Darwinian period was that of Thomas Henry Huxley (1825–95), whose learning, judgment, and skilled advocacy made him a second founder of the science in Britain, and moreover the leading spirit in an 'evolutionary' movement far outranging his own anatomical and zoological contributions. The notion of natural selection and survival of the fittest was applied to arts and crafts by General Pitt Rivers, to archæology by John Evans and Augustus Franks, to institutions by John Lubbock, above all in traditions, ideas and beliefs by Edward Tylor, whose establishment at Oxford (1883), through Rolleston's influence, was the first academic recognition of the new study of man.

The practical issue of American slavery revived old controversies and gave scope to the enthusiasms of James Hunt (1832–69), who joined the Ethnological Society in 1856 and was its secretary during 1859–62. Fresh light on the origin of man came from the palæolithic discoveries of Boucher de Perthes, verified by Prestwich and John Evans in 1859; the Neanderthal skull had been found in 1857, and the cave of Aurignac was opened in 1860. But Hunt's enthusiasm failed to rouse the Ethnological Society, and in 1863 he founded the Anthropological, edited the *Anthropological Review*, and published translations of Waitz and Gerland, the leading ethnologists in Germany, and of Gastaldi on Swiss and Italian lake dwellings. The Anthropological Society loved discussions and ranged far afield, to woman's rights, the Irish question, and above all the Negro question. Its first chairman was Sir Richard Burton. Hunt defended slavery, on the old zoological ground of a plurality of species, at the British Association in 1863, where with Huxley's support a subsection was established for anthropology in 1866 under Section D (Zoology). But Hunt was combative and difficult; he resigned the presidency of his Society in 1867, but remained its 'director' until his premature death in 1869.

The way was now open for reconciliation. The Negro question had been settled by the American Civil War; Huxley in the chair of the Anthropological Society, and Beddoe of the Ethnological, rallied men of goodwill on all sides, and in 1871 was

established the Anthropological Institute of Great Britain and Ireland with Sir John Lubbock as its first president. With the financial help of the British Association, the revised "Notes and Queries in Anthropology" were published; the Anthropometric Committee of 1875 gave much needed definition to physical anthropology; and its annual measurements of the members of the British Association did much to popularize statistical treatment of its problems. Organized by Francis Galton, this was the precursor of the Galton Laboratory at University College, London, and of the systematic study of biometry and eugenics in Britain.

When the original library and museum, at 4 St. Martin's Place, W.C.2, were pulled down, the good offices of the president of 1883–85, William Henry Flower, secured an appropriate home in the upper part of the Zoological Society's house at 3 Hanover Square. This arrangement, however, was nearly disastrous to both institutions, for the weight of exhibits from the first excavation of Stonehenge (1901–2) irretrievably damaged the building and hastened the transfer of the Zoological Society's offices to Regent's Park. By this time the close association of the Institute with the ethnological staff of the British Museum, inaugurated by Augustus Franks and extended by Charles Hercules Read and others down to the present time, drew the Institute into a succession of abodes in Bloomsbury, the last of which, 21 Bedford Square, is within a few yards of the original meeting room in the house of Thomas Hodgkin.

Of the mature work of the Institute only outlines are possible here. Like its predecessors, it has never been rich, and has owed much to benefactions supplementary to its normal income; from the Carnegie Trustees for the improvement of its valuable library, from the Rockefeller and Laura Spelman Rockefeller Foundations to maintain its *Journal*, and from other friends for a few small expeditions. But it has never had the popular appeal of the Zoological or the Royal Geographical Society, or the support of academic or industrial interests. Side by side with its proper business of the promotion and publication of research, it has never ceased to urge on the Colonial Office and other public agencies the pressing need for expert acquaintance with the customs and mode of life of the native peoples of the British Empire; but until recently with disappointing response, in comparison with stately institutions such as the Colonial Institutes of the Netherlands and of Belgium, and the Bureau of Ethnology in Washington. Even the urgent task of recording institutions and modes of life which have been fading away before our eyes has been postponed irretrievably. The inevitable dissipation of energies in specialist societies has been minimized by the establishment of research committees within the Institute itself, for India, Africa, Anthropometric Standards, and the like, and of a Joint Committee for Anthropological Research and Teaching, on which universities and independent institutions are entitled to be represented, which has no parallel in other branches of learning in Great Britain. In the generation following the war years 1914–18, as the spokesman of that Joint Committee, the Anthropological Institute has twice taken decisive part in the organization of the International Congresses for Prehistoric and Protohistoric Sciences (London 1932, Oslo 1936) and for Anthropological and Ethnological Sciences (London 1934, Copenhagen 1938), which have provided at least the constitutional foundations for world-wide co-operation on liberal lines in time to come.

ACTIONS OF DRUGS

ABOUT two hundred and fifty persons attended a discussion in London on September 24 organized by the Faraday Society and entitled "Modes of Drug Action". The meeting lasted six hours and a wide ground was covered by the papers, which had been circulated in proof. These papers contained much interesting matter and it was perhaps unfortunate that too large a proportion of the available time and energy of the meeting was devoted to listening while they were expounded. In the following account the order in which the papers were given has been altered.

Prof. E. K. Rideal, who took the chair, paid a tribute to Sir William Hardy, who was responsible for initiating these joint discussions between biologists and physical chemists. Sir Henry Dale, in his general introduction, stressed the complexity of the problems of pharmacology and warned the meeting against the optimistic adoption of simple theories to explain complicated facts. Most of the generalizations that have been made have exceptions, and it is on these that attention should be focused.

Prof. J. H. Gaddum discussed the antagonism of drugs, and the quantitative relations between the antagonists. It is important to distinguish two kinds of interaction, both of which may give rise to graded antagonism over a wide range of concentrations. Some antidotes neutralize poisons by forming inert compounds with them, as SH- compounds do with mercury. In this case the study of the antidote throws no light on the action of the drug on the tissue. Its action is merely to reduce the concentration of free poison present.

Other antidotes act by competing with poisons for chemical groups essential to living tissues. The study of these is more interesting, since it allows drugs to be classified according to their antagonists, and may provide evidence about the particular chemical processes in the cell with which the drugs interfere. The work of Woods on the antagonism of sulphanilamide and *para*-aminobenzoic acid is a striking example of work in this field. The quantitative relationships between antagonists were discussed. If the reactions are of the first order, the ratio of the concentrations of the two drugs which together produce a given effect should be constant, provided that the concentrations of one drug are calculated as differences from the threshold concentration. This is true whether the drugs neutralize one another or compete, so that it is impossible to distinguish the two kinds of antagonism except from independent evidence that the drugs either combine with one another or have molecules which would be likely to combine with similar groups in the tissues.

Dr. H. R. Ing discussed the theory that drugs combine with specific receptors in tissues and the extent to which it can be used to interpret the relation between chemical constitution and pharmacological action. When a series of allied drugs is studied, it is often possible to recognize pharmacodynamic groups which appear to be essential for one particular type of action. It might be said that this group is essential for combination with the receptors, but there are anomalies. The same pharmacodynamic group is commonly present both in active drugs and in their antagonists. The results can be explained in terms of competition between the two drugs for the receptors, if it is assumed that one of them causes an active response and the other blocks the receptors

but causes no response. Since drugs with a feeble action do not antagonize drugs with a greater action on the same receptors, the response must depend only on the amount of drug combined with the receptor and not on the magnitude of its effect when so combined, which must be all or none. The receptor theory provides a useful intellectual framework for the consideration of the qualitative aspects of the problems presented by the structure and action of drugs. We do not know enough of the receptors to predict the effects of minor changes in the molecule.

The relations between *in vivo* and *in vitro* actions of chemotherapeutic agents were discussed by Dr. H. McIlwain. He gave an able summary of the extensions of the theories of Fildes and Woods which have enabled him to discover new types of therapeutic agent by using substances similar in chemical structure to the normal metabolites of bacteria. The results obtained in the body are complicated by variations in the concentrations of antagonistic substances, and by the actions of the body on the drug and the drug on the body. These interactions are not always the same in different species of animal and under different conditions, and a complete picture can only be attained by correlating observations on whole animals with those obtained *in vitro*.

Sir Rickard Christophers gave an account of work on the metabolism of the malaria parasite, which consumes oxygen at a high rate ($Q_{O_2}=35$) and utilizes glucose if it is present, but can utilize various other foodstuffs in the absence of glucose. Drugs which are used in the treatment of malaria inhibit the oxygen consumption when they are present in concentrations such as may occur in the blood in treatment. This work provides an opportunity for studying the action of these drugs *in vitro*, and so measuring the activity of drugs, without having to consider the complicating effects of differences in their rates of absorption and excretion.

Dr. E. M. Lourie discussed the failure of some arsenical drugs to penetrate the blood-brain barrier and so to act on trypanosomes in the brain in the late stages of sleeping sickness. The best method of studying this problem is probably the estimation of the trypanocidal power of the cerebrospinal fluid when the drugs are administered; but even then, drugs may reach the fluid through the choroid plexus without ever coming in contact with the brain cells. There is some evidence that acid compounds penetrate the barrier more readily than basic or neutral compounds.

The relation between the chemical structure of organic arsenicals and their combination with trypanosomes was dealt with by Dr. H. King. He divided these drugs into three classes; some, like phenylarsenoxide, are active because their properties make them concentrate at lipoid interfaces; some, like atoxyl, show large differences in their actions on normal strains and drug-resistant strains of trypanosomes, and these probably combine with the organism in the same way as acridine dyes; others, like phenyl glycine arsenoxide, are probably not concentrated in the organisms at all. These factors control the combination between drug and organism. The subsequent action of the drug probably depends on quite other factors, such as a combination with SH- groups.

Dr. J. H. Quastel discussed the action of narcotics, and of amphetamine, on the central nervous system. Narcotics reversibly inhibit the oxygen uptake of minced brain, or of brain slices, in concentrations similar to those occurring during anæsthesia in the whole animal. The effect is most marked when the substrate is glucose, and is almost absent when the substrate is succinate. They also specifically inhibit glycolysis in other tissues; but there is evidence that the brain is particularly dependent on glucose metabolism, and that may be why the brain is particularly susceptible to narcosis. Tyramine, and some other amines, cause a diminution of the respiration of brain, which increases with time and is due to an aldehyde formed from tyramine by amine oxidase. It is suggested that the wakening effect of amphetamine, and other amines which inhibit amine oxidase, is due to inhibition of the formation of aldehydes, which are normally present and which normally cause a partial depression of the central nervous system.

Prof. F. Weigert described experiments on the fate of benzpyrene in the body. The long latent period in the carcinogenic action of this substance raises the question whether it persists throughout this time as such, or is changed into some other carcinogenic substance. The substance itself and some of its products in the body can be detected by their fluorescence and purified by chromatography. One of these products is particularly liable to collect in the tissues where cancer is liable to occur, and may be the immediate cause of the cancer.

Prof. E. K. Rideal discussed the general question of the combination of drugs with tissues in terms of electron chemistry. The forces involved are complex and can profitably be studied by measuring the energy of adsorption of drugs on proteins, by the chromatographic method and by putting drugs in solution beneath monolayers in a trough. The application of these methods to pharmacological problems is still in an embryonic stage, but holds the promise of explaining the behaviour of drugs in terms of the detailed constitution of their molecules.

Dr. J. H. Schulman emphasized these views by giving actual examples. It has, for example, been shown that the lytic activity of a series of surface-active long-chain paraffin ionic salts bears relation only to their surface activity at a cholesterol or protein interface, and in no way to their effect on the surface tension at an air-water interface. The optimum activity of synthetic oestrogens is correlated with their adsorption at a protein interface. The adsorption of proteins causes precipitation of lipoid emulsions provided that the charge on the protein is the opposite of that on the emulsion. The effects of using emulsions with different charges, and different proteins at different hydrogen ion concentrations, can be successfully predicted from this theory.

Dr. H. Hurst spoke at some length of the actions of drugs on insects, and emphasized the fact that when the drug is applied to the outside of the insect its action is very much influenced by the permeability of the cuticle. His views on this subject have recently been published in NATURE (**152**, 292; 1943).

Three papers from the Physical Chemistry Laboratory at Oxford described studies of the growth of *B. lactis aerogenes* in artificial culture. There is normally a lag-phase followed by a phase of exponential growth, and the growth then slows up again and the population eventually becomes constant. Dr. R. M. Lodge and Prof. C. N. Hinshelwood described the adaptation of the organism when it is transferred from bouillon to a simpler synthetic medium. In the first few subcultures growth is slow, and abnormally long, snake-like cells are formed. It

is concluded that separate mechanisms, responsible for (*a*) the removal of growth inhibitors, (*b*) elongation and (*c*) division, become adapted at different rates to the new medium.

Dr. G. H. Spray and Dr. R. M. Lodge described the effects of resorcinol and *m*-cresol, which cause a prolongation of the lag rather than a slowed rate of growth, or a diminution of the stationary population. Resorcinol is eventually completely inactivated by the bacteria, but *m*-cresol is not. Long, snake-like bacteria can be produced by *m*-cresol under certain conditions. Dr. D. S. Davies and Prof. C. N. Hinshelwood described the effects of sulphonamides, which both increase the lag and reduce the growth-rate, but do not inhibit growth completely even in high concentrations. On subculture in the presence of sulphonamides the organisms become immune to the drug. Thus immunity is at first partial, reversible and specific to the particular sulphonamide (sulphanilamide or sulphaguanidine) used. After thirty subcultures it becomes complete, irreversible and unspecific. The theory that this is due to the selection of resistant organisms is rejected, and it is assumed that the cells develop enzymes which produce a sulphonamide antagonist. The partial antagonism which develops earlier is probably due to other causes.

A full account of the meeting will appear in the *Transactions of the Faraday Society*.

J. H. GADDUM.

AREA HEATING

THE publication of recent technical papers* on so-called district heating emphasizes a grave omission in the County of London Plan; indeed, the term is mentioned a few times, but there is no consideration of the very great contribution this development of applied science can make, on several grounds, to the social development of large population groups which have arisen in Great Britain, especially the conurbation of London. The subject is very briefly mentioned in the exhibition of planning now open at the Institution of Civil Engineers, held jointly by that body and the Institution of Municipal and County Engineers. Twice in the last twenty years St. Marylebone Borough Council, which generates its own power, discussed supplying the local housing estates with heat, but failed to grasp the opportunity of obtaining experience in this field.

There is a ray of hope, however; Coventry has just agreed to incorporate district heating in its reconstruction programme. The local authority still has to convince the Electricity Commissioners, and then bring a Bill before Parliament. Further, the Public Works Committee of Bristol has had submitted to it a plan to cover the central area of that city.

The major public difficulty is that the existence of district heating is not obvious. It is not like a railway, bridge, or power-transmission line, which anyone can observe or appreciate for use or value. District heating is not known in Great Britain, whereas it is a national policy in the U.S.S.R.; Russian schemes already dispose of more heat than is conveyed by all the town-gas in Britain. Hamburg has had it on an increasing scale for half a generation, and each of the latest German schemes is larger than the New York plant, which uses 775,000 tons of coal annually.

What, then, are the virtues of district heating?

Practically all electric power in Great Britain is generated by high-pressure and high-temperature steam, dropping its entropy in turbo-generators. The maximum working efficiency of energy conversion from coal to electricity is not likely to exceed 30 per cent in the most modern, and consequently all new, power stations; it averages 20–25 per cent. The major loss is in the condensation of the steam at low-pressure, necessary for the operation of steam turbines; that is, the latent heat is wasted. In other words, every large power station is throwing away a million kilowatts continuously into the local river or its cooling towers.

The usage of electric energy is increasing at a rapid rate, and in many large places, which provide centres of gravity of electric loading, new power stations will be required. London after the War will, it is probable, require several new power stations or great extensions to cope with the increasing load. The more electric energy is used under the present system, the more coal energy is wasted. The natural and obvious proposal is to utilize this wastage of heat for domestic and process work in the neighbourhood of these power units.

Continental practice shows that a distribution of this waste heat is easily economical up to seven miles, and, in favourable circumstances, several times this. It is calculated that with reasonable capital expenditure, which can be amortized in between five and fifteen years, depending upon the particular circumstances, such heat can be sold at not more than 4*d*. per therm; this would make important contributions to coal conservation.

A more attractive scheme is to burn the coal in boiler stations, in which can be realized efficiencies of conversion up to 90 per cent, on the rim of large centres of population, transmit the steam through large pipes to turbo-generators located at the centre of gravity of the electric load, and dispose of the heat, which otherwise would be wasted, in the surrounding domestic and industrial areas. The wastage of heat in such pipe transmission is of the order of 1 per cent for seven miles, because of the very large diameter required; the pipe need not be lagged with heat-conserving material. In one step we save the expensive area required for a coal depot essential now to every power station, the consequent dirt which arises from coal and ash handling, and any more which is permitted by expensive smoke cleaning plant to escape through unsightly chimneys; we have saved not only the cost of expensive condensing plant, and cooling towers on non-river sites, but also, in the latter case, expensive ground and the enormous amount of condensation which is inevitable in their region during humid weather. The problem of noise arising from generators in a comparatively small building can easily be coped with by modern methods of noise control.

Having decided to dispose of hitherto wasted heat—and it may be remarked that it is not possible to extract much heat from existing power stations because the full benefits are not realizable without special designs of back-pressure turbines—the problem is to distribute such heat in the form of hot water or steam at high pressure to the situations where it can be utilized. Naturally, the regulation of demand, which would not be exactly in step with the electric power demand, causes some difficulty, but this can be overcome by having adjustable back-pressure on the turbines with suitable heat-reservoirs, these taking the form of lightly heat-insulated steel water-

* *Electrical Times*, Sept. 30 and Oct. 14, 1943; *Engineering*, Oct. 8, 1943; *Industrial Heating Engineer*, July–Oct. 1940.

towers; the pipe-lines would be tapped to convert the heat through thermostatically controlled calorifiers in consumers' premises. The County of London Plan, with its new roads, both radial and ring, offers not only suitable routes for the large piping which would be required for the main heat transmission routes, but also, since these routes go through areas which are intended for planning on the ten-story-block-of-flats principle, the latter could be designed immediately for district heating with a minimum of capital expenditure, thus saving valuable boiler accommodation and fuel storage.

With regard to competitive forms of heating, the Engineers' Study Group on Economics, collecting information from many organizations, had previously deduced that it is in the national interest to use gas rather than electric power for basic domestic heating, the point being that if large sections of the population could be persuaded to abstain from wastefully using soft coal in domestic hearths and to use coke or other low-temperature carbonized coals instead, it will be necessary, in order to provide such hard fuel at reasonable cost, economically to get rid of great quantities of the minimum gas which is necessarily involved in producing any specified quantity of hard fuel. Prof. C. L. Fortescue, in an informal discussion at the Institution of Electrical Engineers, also arrived at the desirability of increased domestic heating by gas from other arguments. Thus there is competition on technical, social, and economic grounds between district heating by waste-heat from power stations, and domestic heating by means of gas. Electric power is so precious and high-grade that it must be considered out of the question for basic domestic heating, except in special circumstances.

A further reason for the usage of gas for basic domestic heating is the technical one of regulation. It is well known that in suburban areas in which domestic gas-cooking is prevalent, the drop in pressure at the peak-loading, especially for Sunday dinners, is serious. It is therefore desirable to use electric power for cooking, because of its high regulation, which is also essential for lighting and normal power requirements. We are thus led to conclude that electric power should be reserved for those applications where good regulation is desirable, and gas should be used where, through automatic control, such as in gas central heaters, which have been hitherto little used in Great Britain, close regulation is not essential.

What case, therefore, can be made for district heating? It must be based on the fact that electric power is increasingly demanded, and therefore there is a waste of energy, as explained previously. It follows, therefore, that in the national interest district heating should be used where practicable and economic, the gaps being filled by gas. Electric power should be reserved for those applications where it is most effective, such as electric traction, electric lighting, and the manifold large and small power uses where its delicacy of control gives it an advantage over any other competing form of power.

On social grounds, district heating would, at one stroke, if carried out on a large scale in large centres of population, dispose of the necessity of the traditional domestic fire and the consequent wastage of heat into the open sky, the pollution of the atmosphere with unconsumed carbon, and the wide-scale deterioration of buildings because of the sulphur acids emitted into the atmosphere. The point here is that whereas in large power stations the exhaust gases can be cleaned efficiently, or so dispersed in countryside areas that their effect on man and Nature is substantially zero, there can be no such control over the tiny combustions which occur, to the number of millions, in domestic premises. The general adoption of central heating which has taken place in other countries may not be desirable in Great Britain; in fact, the ideal for our more moderate but erratic climate would be semi-central heating, topped up with a small amount of radiation, gas or electric. In this way the great value of our climate—its variability between extremes which are small in comparison with climates in other parts of the world—is conserved, both indoors and without.

L. E. C. HUGHES.

OBITUARIES

Mr. A. C. Gardiner

ALAN GARDINER died on August 29 at the age of forty-six. The news came as a great shock to his many friends, and hydrobiology suffered a severe loss. He was educated at Oundle and Gonville and Caius College, Cambridge, and inherited a love of science from his brilliant father, the late Dr. Walter Gardiner. As soon as he had graduated in 1920 he began the line of research which always continued to attract him: the problems of plankton ecology, sometimes freshwater, sometimes marine, and refinements in the methods of attack. This work, although broken by periods of illness, was always taken up again, and he was actively pursuing it at the time of his death.

His first investigations, in collaboration with the late Mr. Rowland Southern, were made over several years from a floating laboratory on the River Shannon where it flows into Loch Derg. The amount of data they amassed, biological, physical and chemical, was enormous; in studying the diurnal migration of the animals they at times kept up their sampling and recording at intervals through the day and night for a week or more on end. The working up of all this material took many years, and their splendid studies of lake and river plankton appeared at intervals from 1926, long after the field work was completed. Southern died in 1935, but Gardiner finished the great work in 1938.

Leaving Ireland, Gardiner was appointed in 1924 to the research staff of the Ministry of Agriculture and Fisheries and took up the problems of freshwater biology in relation to pollution at the ministry's laboratory at Alresford. Here came his first serious breakdown in health, and he was forced into exile to Switzerland. On his return he joined the marine Fisheries Laboratory at Lowestoft and devoted himself to such problems as the effects of patchiness in distribution upon the validity of plankton sampling, the quantitative efficiency of nets and the vertical distribution and migration of plankton animals. Ill-health forced him to resign and go back to Switzerland where, as he wrote in a letter, he was teaching "Chemistry, Mathematics, 'As you like It' and 'The Acts of the Apostles' in a school for backward boys".

Better once more, Gardiner was appointed in 1935 to the staff of the Metropolitan Water Board and threw himself enthusiastically into seeking solutions to the many problems of waterworks biology. He was particularly concerned with the factors under-

lying the incidence and duration of the diatom outbreaks which are often of such serious consequence in the clogging of filter beds. Having shown that their rate of growth could only be correlated with abundance of phosphate and silicate in the early part of the season, he was investigating the causal conditions acting later in the year. At the time of his death he was experimenting along several new lines of diatom culture and improved methods of estimating populations.

Gardiner never lost his interest in the sea. Thinking that animals must materially alter the phosphate content of the water by their excretion, he took a brief busman's holiday on the research ship *George Bligh* and, by the simplest experiments, with live plankton animals taken straight from the sea, at once proved his contention. This important factor in marine ecology had hitherto been completely overlooked, and much more will be heard of it in the future.

Gardiner's work had a splendid quality. After reading the late Sir Arthur Hill's account of his father ("Obituary Notices of Fellows of the Royal Society", vol. 3, 1941), one realizes that he inherited not only his love of biology but also his keen faculty of self-criticism and clear thinking; he was always striving after improved methods and greater accuracy. His most recent paper, published since his death, is typical of him: a critical examination of the pigment extraction method of measuring phytoplankton production.

I cherish many memories of him: of sharing a study at Oundle, of natural history expeditions with him both at school and in the holidays, of grand days together at sea on the *George Bligh* and latterly of his happy married life in London. From his early school days he was a martyr to asthma, to an attack of which he finally succumbed. All his life he battled with his health, but for ever made light of it. What a spirit he had, what courage, what a grand sense of humour! From a sanatorium in Switzerland he was a frequent contributor to *Punch*. When things must have looked their blackest his letters still sparkled with fun. He will be missed by so many, missed for his cheerful good company, for his intellectual honesty and for his sound reliable work. But for his ill-health how much more he would have done; in spite of it, how astonishing that he did so much! It is good to learn that the Freshwater Biological Association is to assist in the bringing of his unfinished work to publication.

Our sincerest sympathy goes to his wife and to his mother. ALISTER C. HARDY.

Prof. A. A. Read

ARTHUR AVERY READ was born at Honiton, Devon, in 1868 and died at Bournemouth on September 24, where he lived after his retirement from a tenure of forty years of the chair of metallurgy in University College, Cardiff. He was educated at Exeter Grammar School, Owens College, Manchester, and at the University of Sheffield (then the Technical School), where he studied metallurgy under the late Prof. J. O. Arnold. He went to Cardiff from Sheffield in 1894 as the first lecturer in metallurgy, and on his retirement in 1933 he had completed his life's work by the establishment of a department worthy of the University of Wales, housed in a modern building, which had been erected with the financial assistance of the Monmouthshire and South Wales Coal Owners' Association.

Read's enthusiasm for his work was such that the new department flourished, and he had the distinction of training the first man to obtain a B.Sc. degree qualification in metallurgy in Great Britain. Many of his former students have become distinguished men in the metallurgical world.

Read realized that a university has a two-fold obligation—not only to teach but also to prosecute original research; and he managed to keep an even balance between these two while at the same time he worked hard to build and equip his Department. His research work, in collaboration with Arnold, on the chemical relations of carbon and iron with various other elements such as manganese, chromium, vanadium, tungsten, cobalt and molybdenum, which were published over a period of years from 1895 until 1915, have proved of great value in the development of modern alloy steels. His interests in non-ferrous metallurgy resulted in the publication of several papers dealing with alloys of nickel, aluminium and copper, work with which Dr. R. H. Greaves was associated.

Outside College, Prof. Read was interested chiefly in the Volunteers and Territorials, and he received the Territorial Decoration. During the War of 1914–18 he was away from College on national service. After the War the University of Wales, and the College at Cardiff, both young institutions, were faced with serious problems, and Read sacrificed his personal inclination to resume his researches and applied himself energetically to University affairs. He brought to bear on academic matters an administrative outlook which was of inestimable value. His work was recognized by the University conferring on him the degree of D.Sc. *honoris causa*.

Read, always an inspiration to his students, won their respect for his straight dealing and then their affection for his kindliness and his readiness to champion their cause. W. R. D. JONES.

Mr. F. Napier Sutton

FREDERICK NAPIER SUTTON, a former alkali inspector in the Ministry of Health, died on September 24, aged eighty years. He was the eldest son of the late Mr. Francis Sutton, public analyst of Norfolk and Suffolk, and the author of the text-book "A Systematic Handbook of Volumetric Analysis".

Mr. Sutton was, for a very long period, works chemist to Messrs. Baily, Sutton and Co., of Great Yarmouth. In 1885 he was appointed assistant to the chief inspector (the late Alfred Fletcher) under the Alkali, etc., Works Act; he was promoted to sub-inspector in 1892 and to inspector in 1908. He retired on reaching the age of sixty-five in December 1927, having then served for forty-two years, during thirty-five of which he was in charge of the London and south-eastern counties district.

After his retirement and, indeed, up to the time of his death, he continued to take a great interest in the affairs of the Alkali Works Department of the Ministry of Health and in chemical industry generally. During 1892–1916 he was secretary of the London Section of the Society of Chemical Industry.

Mr. Napier Sutton was devoted to chamber and orchestral music, and for many years he was a player in some of the leading amateur orchestral societies. He was an expert trout fisherman, and a gifted 'dresser' of trout flies. He was greatly beloved by all his colleagues, and his passing will be widely mourned.

NEWS and VIEWS

U.S.S.R. Academy of Sciences

AT a recent meeting of the Academy of Sciences of the U.S.S.R., thirty-six new academicians and fifty-eight corresponding members were elected. Among the chemists elected were Profs. Dubinin and Nesmeyanov, who have studied the chemistry of metallo-organic compounds, also Profs. Rodionov and Chernyayev, the well-known organic chemists. The geologists included F. Savarensky, a geologist who did valuable work in connexion with the construction of the Moscow–Volga Canal and the Moscow underground railway; Prof. Belyankin, a leading petrographer, who has helped greatly the industrial development of the Urals; Prof. Smirnov, a leading mineralogist of the Leningrad Mining Institute; and Prof. Satpayev, who represents the Kazakhstan branch of the Academy. Among the physicists were Lebedev, the well-known experimental physicist; Khristianovich, who has made investigations in mechanics; Alikhanov, who has studied the physics of the atomic nucleus; and Kurchatov. The biologists included the botanist Sukachev, the histologist Zavarzin and the Ukrainian pathologist Strazhesko. On the applied side, Major-General Blagonravov was elected to the Department of Technical Sciences, as were A. Mikulin, A. Yakovlev and V. Klimov, designers for aviation. The inventor of a new gun, A. Kostekov, was elected and also the Ukrainian economist, M. Ptukaha, who is charged with reconstruction duties.

Post-War World Education

DR. GRAHAME CLARK has an article in the September issue of *Antiquity* in which he attempts to integrate the various subjects to be taught in schemes for post-war education round the central idea of the evolution of mankind and his place in the universe. In other words, prehistoric anthropology—the study of our common origins—is to be the cement which will bind together the common education of the post-war nations of the world. The article is very interesting and thought-producing, and should be read by all concerned with post-war education. Considered on a university level, there is much to be said for Dr. Clark's thesis; whether his conceptions can possibly be adapted to the primary levels of teaching—to the brain of the child who is necessarily occupied with such problems as the writing of his own language correctly and the doing of his sums—is quite another matter. For, after all, education is not entirely 'book learning'.

Few to-day would deny that the twofold purpose of every educationist concerned with the upbringing of both children and adolescents is, first, to teach them how to live, and secondly to stimulate their interest in and to impart knowledge. Carrying the matter a stage further, the first of these can be subdivided into (1*a*) the art of living alongside one's neighbour, and (1*b*) the power to stand four-square with a reasonable personal independence *vis-à vis* the material world. It is especially in this connexion that the various youth organizations play such an important part, and quite frequently and rightly are closely connected with the schools. The other object of education can be subdivided into (2*a*) the imparting of information useful for technical purposes, for the job in life to be undertaken by the individual, and (2*b*) the imparting of purely cultural information. (Naturally 2*a* and 2*b* often overlap. What is of technical importance for one man may be of purely cultural interest to another—the professional geologist may be interested in Plato, while the classical teacher may have a private passion for geology.) It would appear that it is only with 2*b* that Dr. Clark is in the main concerned. Unfortunately, in the past it has been just this side of education that has least interested the average Englishman, though to-day those who are actively keen on education can detect a change in this respect. There is no doubt that our curricula need an overhaul, and Dr. Clark's plea for prehistory and anthropology as basal subjects should be borne in mind.

District Heating in New York

CURRENT discussions on fuel economy and planning for the future give a special interest to details recently published (*Steam Engineer*, **12**, 222; 1943) of the largest district heating scheme in the United States. In the new Parkchester residential community in New York, the central heating of a whole building from one boiler plant gives place to the central heating of a whole district from a single boiler house. The site for this vast scheme is an area of 129 acres occupied to the extent of 26·4 per cent of buildings, 21·2 per cent of avenues and 51·4 per cent by lawns and walks. Accommodation for 40,000 people is provided in the 42,464 rooms of 51 blocks of flats, along with garages and a theatre. The central boiler plant, housed in a building 180 ft. × 75 ft., and including a chimney more than 300 ft. high, consists of four oil-fired boilers. From these the live steam is circulated on the return condensate system in a vast closed circuit. Instead of fitting a valve on each radiator in a room, a damper is used to control the heat. By this means leakage of air into the closed circuit through a multiplicity of valves is much reduced. The outside walls of each building are heavily insulated by a 1-in. thick spun glass layer together with a layer of air between the brick and plaster of the outside walls. This extra insulation alone is claimed to save £8,000 worth of fuel in a year. Details are not given of the thermal efficiency of the transmission system. As the last building was ready for use in 1941, the whole scheme will have had a thorough trial by the time post-war reconstruction begins. The average cost to the individual is about £2 15*s*. per month per room including heat and light, and the flats, consisting of from two to five rooms, are designed for people whose income is from £360 to £900 a year.

Medical Research in War-time and the Relief of Suffering

Two recent addresses are deserving of attention in that they deal with new advances in medical research. One is Sir Edward Mellanby's Ludwig Mond Lecture, devoted to a review of medical research in war-time (*Brit. Med. J.*, Sept. 18, 1943); the other is Sir Henry Dale's Frederick Price Lecture (*Brit. Med. J.*, Oct. 2, 1943) on the remarkable recent advances in chemotherapy, all of which have been made in the comparatively short interval between the War of 1914–18 and the present War. Sir Edward Mellanby refers to "endless references in religious, theological, and even philosophical addresses", to the prostitution of science, especially for the purposes of war, and to "some suggestion that there exists in

science and scientific men a kind of wickedness not shared by the humanities and by those engaged in their study". This kind of tilting at science is familiar enough. It springs from a failure to recognize that science is neither good nor evil; it is man who uses science for his good or evil ends. No one who reads these two addresses can avoid the conclusion that science can be, and is being, used for wholly beneficent ends and that countless men and women all over the world, as well as countless technicians who assist them, are devoting their lives to the betterment of the lot of humanity and sometimes are losing their lives in this service.

Sir Edward Mellanby's address deals with the organization and duties of the Medical Research Council and with organized medical research on blood transfusion, nutrition, problems of drug supply, the emergency public health laboratory service and the application of medical research to the needs of the fighting services. He inevitably makes contact, through his references to the sulphonamide drugs and to penicillin and other antiseptics, with Sir Henry Dale's more detailed history of these and other pharmacological discoveries. Sir Henry points to future fields of work and to still more remarkable benefits to come. We live, it is clear, in one of the greatest hours of medical history. The depreciators of science should consider, after reading these two records of lives saved, suffering reduced and hope for a better future securely established, whether science, properly used, is not one of the greatest of the humanities. Has any other human activity brought, in so short a time as the interval between the War of 1914–18 and that of to-day, so much effective and practical aid to the sick, the distressed and the broken in mind and limb?

Glaxo Laboratories' Products

THE flavines or amino-acridines have long been known as antiseptics that are particularly effective in the presence of serum, which diminishes the activity of most other antiseptics. Acriflavine, which is the one generally used, has also trypanocidal powers, hence the name trypoflavine. Glaxo Laboratories, Ltd., of Greenford, Middlesex, have just introduced 2 : 7 diamino-acridine hydrochloride and 5 : amino-acridine hydrochloride. The former is stated to have the least toxicity of all the flavines, and, while not interfering with healing, to be rapidly bactericidal. It is effective against certain Gram-negative organisms not affected by other acridines in similar concentrations. The latter is a non-irritant antiseptic with an antibacterial activity similar to that of other flavines and has the advantage of not staining the skin.

Other products which this firm is introducing are nicotinamide, which possesses a similar therapeutic value to nicotinic acid without producing the uncomfortable flushing and other skin reactions so common with the acid, and Suspended T.A.B. Vaccine (synthetic culture medium). It is stated that by using a synthetic culture medium free from the protein and other substances contained in the usual bacteriological broth and nutrient agar, reaction from the use of such substances is avoided. The full antigenic properties of the organisms are retained, while the absence of protein from the culture medium restricts the reaction to that produced by the bacteria themselves. It is claimed that the reactions from this T.A.B. vaccine are few, principally of local pain and stiffness at the site of the injection, while the antigenic response is extremely satisfactory.

Colonial Fisheries Advisory Committee

THE Secretary of State for the Colonies has appointed a Colonial Fisheries Advisory Committee to advise him on problems concerning fisheries (marine and freshwater) in the Colonial Empire, in association with his fisheries adviser. The committee is constituted as follows: The Duke of Devonshire, Parliamentary Under-Secretary of State for the Colonies (*chairman*); Mr. G. L. M. Clauson, Colonial Office (*vice-chairman*); Dr. S. Kemp, director of the Marine Biological Association of the United Kingdom; Dr. E. B. Worthington, director of the Freshwater Biological Association of the British Empire; Dr. E. S. Russell, fisheries adviser to the Secretary of State for the Colonies; Dr. G. A. Reay, director of the Torry Research Institute (Department of Scientific and Industrial Research), Aberdeen; Dr. B. S. Platt, in charge of investigations into nutrition in the Colonial Empire under the Medical Research Council; Mr. J. R. Norman, deputy keeper, Department of Zoology, British Museum (Natural History); Dr. C. F. A. Pantin, reader in invertebrate zoology, University of Cambridge; Mr. R. S. Wimpenny, naturalist, Ministry of Agriculture and Fisheries; Mr. J. Thomson, chief inspector of fisheries, Ministry of Agriculture and Fisheries; Mr. Morley Neale, member of the firm of Messrs. Neale and West, steam trawler owners, Cardiff; Mr. C. N. Hooper, clerk of the Fishmongers' Company; Mr. R. H. Burt, Colonial Office (*secretary*).

Telecommunication

IN his inaugural address to the Institution of Electrical Engineers on October 7, Sir A. Stanley Angwin, president of the Institution, gave a survey of the possibilities of development of telecommunications in the international field, dealing particularly with the subject of international control and regulation and its repercussions on post-war developments in Great Britain. In dealing with international control and standardization, Sir Stanley referred to the various administrative international regulations which had come into being and to the three technical committees which studied technical questions relating to the methods of working communication channels. Reference was made to other international organizations dealing with the application of communication for a particular purpose.

The necessity for emphasis being given to the adoption of a technical basis in determining international frequency allocations leads to consideration of the three consultative technical committees referred to in the address, and the three divisions of the communications with which they deal, namely, telephony, telegraphy and radio communication. Sir Stanley dealt with the provisions to implement these services on an international basis. Reference was made to the possible developments in connexion with television, but how far these will be divided between radio and line transmission has yet to be determined. How far the employment of micro-waves for radio transmission or the new mechanism of electrical transmission by wave guides will meet the needs of television is one of the intriguing problems of the future.

New 50-Kilowatt C.B.S. International Broadcasters

AMONG the foremost short-wave radio broadcast stations in the United States are the C.B.S. International Broadcasters located on Long Island, New York, which transmit around the clock in twenty-three

languages and dialects to South America, Central America, the West Indies, Mexico, Europe, Africa and Asia. Inaugurated as a part of the Columbia Broadcasting System on January 1, 1942, the new station now operates regularly with three transmitters simultaneously consisting of two 50-kW. carriers, provided by new equipment designed and manufactured by the Federal Telephone and Radio Corporation, and the 10-kW. carrier of an older unit which was moved to Long Island from Wayne, New Jersey. The transmitters operate with a total of thirteen directive arrays, using nine frequencies from 6 to 22 mc. The antenna design provides a gain of 16 decibels over a conventional half-wave antenna in free space, due to the directional characteristics, making the effective radiation equivalent to almost 2,000 kW.

The C.B.S. station is located on the 1,200-acre site of the Mackay Radio and Telegraph Company's overseas short-wave commercial radio stations on Long Island. In one case, the C.B.S. transmitters are operated on a Mackay antenna simultaneously with Mackay transmission. This is practicable since the type of antenna employed functions efficiently with more than one transmitter, provided the frequencies are separated by at least five per cent. All the C.B.S. transmitters are housed in a new, single-story wing, 40 ft. × 60 ft., with basement, added to the existing Mackay transmitter building. Three exciters and three 50 kW. final amplifiers are provided. The additional radio frequency equipment allows the operators to pre set the frequency of one radio-frequency section while the other two radio frequency sections are being operated simultaneously. Instantaneous change-over to the pre set frequency may then be accomplished by operating the specially designed antenna switch. The transmitting equipment is described by H. Romander (*Elec. Comm.*, **21**, No. 2; 1943) in an article which deals with the station layout, radio-frequency units, radio-frequency drivers, power amplifier, antenna switching mechanism, modulators, power frequency equipment and control system. Photographs and circuit diagrams illustrate the article.

Birth-rates in Germany

ACCORDING to the *Journal of the American Medical Association* of July 31, the latest figures show a dramatic fall in the German birth-rate. In the large German cities the number of births in 1942 declined by 80,000 from 419,000 in 1940, and the rate per thousand of population fell to 13·9 compared with 17·3 in 1940. In the last quarter of 1942 the rate was as low as 12·7. The experience of the German cities is borne out by the rate for all areas of Greater Germany, which declined from 20·4 during 1939–40 to 15·2 in 1942, a loss of approximately 550,000 live births.

Comet Comas-Sola

A TELEGRAM from Lund announces that Miss Oterma has rediscovered Comet Comas-Sola very close to the position predicted by Messrs. Dinwoodie and Henderson in the "Handbook of the British Astronomical Association", 1943. Its magnitude is not indicated. An ephemeris for November is given below.

Date 1943	R.A. h. m.	Dec.	r	ρ
Nov. 4	02 16·3	+0° 55′	2·314	1·341
12	02 08·3	1 12	2·270	1·319
20	02 00·9	1 43	2·228	1·313
28	01 54·7	2 27	2·184	1·322

The Night Sky in November

FULL moon occurs on Nov. 12d. 01h. 36m. U.T. and new moon on Nov. 27d. 15h. 23m. The following conjunctions with the moon take place: Nov. 14d. 10h., Mars 5° N.; Nov. 14d. 21h., Saturn 2° N.; Nov. 19d. 21h., Jupiter 0·7° S.; Nov. 23d. 18h., Venus 3° S. The following occultations of stars brighter than magnitude 6 take place: Nov. 2d. 17h. 36·8m., 115 B.Sgr(*D*); Nov. 2d. 18h. 23·0m., 121 B.Sgr(*D*); Nov. 15d. 01h. 51·4m., 57 Ori(*R*); Nov. 18d. 01h. 50·9m., θ Cnc(*R*). The times are given for Greenwich and *D* and *R* refer to disappearance and reappearance respectively. Mercury is a morning star at the beginning of the month, rising half an hour before the sun, and is in superior conjunction on Nov. 10. At the end of the month the planet rises at 9h. and sets at 16h. 13m. Venus is a morning star, rising at 2h. 40m. at the beginning of the month, and attaining its greatest westerly elongation on Nov. 16 when it rises at 2h. 53m. At the end of the month it rises at 3h.15m. Mars, an evening star in the constellation of Taurus, sets at 11h., 10h. and 8h. 41m. at the beginning, middle and end of the month respectively. Jupiter, in the constellation of Leo, rises just before midnight at the beginning of the month, and at 23h. 08m. and 22h. 15m. at the middle and end of the month respectively. Saturn is an evening star in the constellation of Taurus. The times of setting at the beginning, middle and end of the month are 11h. 07m., 10h. 08m. and 9h. 05m. respectively. The Leonid meteor shower is due on Nov. 13–14 and the Andromedid shower on Nov. 18–25, but for some years both these showers have been very feeble and in some cases practically non-existent.

Announcements

THE thirtieth Thomas Hawksley Lecture of the Institution of Mechanical Engineers will be delivered by Prof. C. E. Inglis on November 15, at 5.30 p.m. He will speak on "Gyroscopic Principles and Applications".

THE Christmas Lectures at the Royal Institution, the hundred and fourteenth of the well-known series "adapted to a Juvenile Auditory", will be delivered by Prof. E. N. da C. Andrade, Quain professor of physics in the University of London, who will speak on "Vibrations and Waves".

LORD HORDER has been elected president of the British Association of Physical Medicine.

THE Rockefeller Foundation has made a grant of 7,500 dollars as a contribution to be used by Prof. F. F. Nord in connexion with his researches in enzyme chemistry at Fordham University, New York.

DR. L. E. C. HUGHES has been appointed head of the Experimental Department of Messrs. Rediffusion, Ltd., at their works at Wandsworth. Dr. Hughes is technical editor of "Chambers' Technical Dictionary", of which a revised edition has recently appeared.

THE Dominion Government of Canada has approved expenditure for establishing plants and equipment in Montreal and Toronto for the production of penicillin. The appropriation will cover the cost of creating the industry and that of the production of the first 20,000,000,000 units of penicillin for use by the Canadian armed forces. The new industry, employing 250 men and women, will come into operation next February.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Distribution of Nucleic Acid in the Cell

In a recent article, Stedman and Stedman[1] claim to have discovered a new protein constituent of chromosomes, termed "chromosomin". They allege that Feulgen's reaction does not demonstrate the location of thymonucleic acid in the cell and they conclude that "the staining properties of the chromosomes towards both basic dyes and Feulgen's reagent are due to their content of chromosomin and the evidence indicating the presence in them of nucleic acid is shown to be fallacious". The argument runs as follows: Feulgen's reagent is colourized when in contact with the hydrolysis product of thymonucleic acid. The colourized product (see Baker[2]) is freely soluble in water, and it may then act as an ordinary basic stain and become attached to the acidic "chromosomin". Thus it is sufficient for thymonucleic acid to be present anywhere in the nucleus for the chromosomes to stain with Feulgen's reagent.

Although these authors do not deny that there may be small amounts of nucleic acid in the chromosomes, they lead one to infer that "there is little material left to form the nuclear sap unless this contains some nucleic acid", and indeed they suggest that the spindle at metaphase is a gel of nucleic acid.

The experiments of Mazia and Jaeger[3], however, show this position to be untenable. These workers digested salivary gland cells of Drosophila with nuclease, and then tested for products of thymonucleic acid by means of the Feulgen reaction: controls showed the chromosomes stained and the cytoplasm unstained, while the treated material showed the chromosomes unstained and the cytoplasm stained. The protein constituents of the chromosomes were nevertheless still intact in the digested cells. Nuclease-treated glands, tested by the ninhydrin reaction for protein distribution, showed the chromosomes staining more intensely than the cytoplasm. The action of nuclease is to break up thymonucleic acid, and the products of hydrolysis then become distributed through the cell: these products colourize with Feulgen's reagent, but the dye-stuff so formed does not then become differentially attached to the residual protein of the chromosomes.

The Feulgen reaction is specific for aldehydes and the pentose radicals of thymonucleic acid. Now, however, the properties of the two other constituents of nucleic acid molecules have enabled nucleic acid distribution to be examined, and the results obtained corroborate or overlap the evidence from the Feulgen reaction. The purine and pyrimidine radicals determine the characteristic absorption spectrum of nucleic acid with a well-marked maximum at 2600 A. in the ultra-violet. Caspersson[4] has shown that the chromosomes have a maximum absorption of ultra-violet light at this wave-length, at which indeed their absorption is vastly greater than that of all other cell components. When the same methods were applied to salivary gland chromosomes, Caspersson likewise showed that the bands which are stained with such nuclear dyes as carmine were also the regions of the chromosomes with a high content of nucleic acid. Moreover the contrast between the absorption by the chromosomes and by the rest of the cell (including the spindle) of light of this wave-length remains clear-cut when the protein constituents of the chromosomes have been digested by trypsin; to prove this, it was necessary, of course, that the thymonucleic acid liberated during the digestion should be precipitated by combination with lanthanum ions in the medium.

These experiments did not rule out the presence of nucleic acid derivatives in other parts of the cell. Caspersson and Schultz[5], again by means of the ultra-violet absorption technique, demonstrated concentrations of ribose nucleotides in the nucleoli and cytoplasm of egg cells and rapidly dividing tissues where the Feulgen reaction gave negative results.

The third line of independent evidence for the distribution of nucleic acid in the cell is available from the micro-incineration experiments of Barigozzi and Norberg. Barigozzi[6] showed that the dark-staining bands of the salivary gland chromosomes give concentrations of phosphorus when incinerated. This we should expect since nucleic acid contains phosphorus in every nucleotide whereas most proteins contain little or none. Norberg's[7] results, based on new photometric methods, confirm and extend those of Barigozzi.

Thus while the results of Stedman and Stedman may require that our views on the protein constituents of the chromosomes be modified, there would seem no justification for radical change in the theory of the distribution of nucleic acid in the cell and of its important relationship to various cell functions[8].

H. G. Callan.

John Innes Horticultural Institution,
Merton, S.W.19.
Sept. 14.

[1] Stedman, E., and Stedman, E., NATURE, 152, 267 (1943).
[2] Baker, J. R., in "Cytology and Cell Physiology", edited by Bourne, G. (Oxford: Univ. Press, 1942.)
[3] Mazia, D., and Jaeger, L., *Proc. U.S. Nat. Acad. Sci.*, 25, 456 (1939).
[4] Caspersson, T., *Skand. Archiv. Physiol.*, Suppl. 8 (1936).
[5] Caspersson, T., and Schultz, J., *Proc. U.S. Nat. Acad. Sci.*, 26, 507 (1940).
[6] Barigozzi, C., *Bull. Histol. Tech. Micro.*, 15, 213 (1938).
[7] Norberg, B., *Acta Physiol. Scand.*, 5, Supp. 14 (1942).
[8] Darlington, C. D., NATURE, 149, 66 (1942).

Mr. Callan, in his defence of the established position of nucleic acid in the nucleus, has completely missed the main significance of our results. Whatever the function of nucleic acid may be, and we have no doubt that it is an important one, and however it may be distributed in the nucleus, its position as the central figure of the chromosomes has disappeared with the discovery of chromosomin. This was the point which we set out to establish in our former article, and we claim that the facts which we have adduced both there and elsewhere[1] give incontrovertible proof of our contention. In dividing cells, chromosomin is quantitatively the major constituent of the nucleus, it is concentrated wholly in the chromosomes, and its presence there supplies for the chromosome theory of heredity a basis which Mirsky[2], and no doubt many others, have recognized could not be filled by either nucleic acid or histone, the only constituents of nuclei hitherto known. We regard chromosomin, in fact, as the chemical basis of inheritance. By this we mean that the type of organism into which a zygote will develop will primarily depend upon the composition of the chromosomin contained in the gametes from which it was formed. We recognize, of course, that it must, within limits, be organized in a definite

manner in the chromosomes. Variations within these permissible limits would, no doubt, account for the existence of different hereditary characters, usually ascribed to genes, within a species or race.

When we turn to the question of the distribution of nucleic acid within the nucleus we realize and admit that we are on more controversial ground. Mr. Callan has, rather uncritically, put forward data which, on the whole, constitute a considerable body of circumstantial evidence in favour of the view which he seeks to maintain. Like other evidence of this nature it is, however, susceptible to collapse when new facts emerge. Mr. Callan virtually ignores the new evidence bearing on the problem which our work has supplied.

Before considering the work of others, we must therefore make our own arguments perfectly clear. Our suggestion that the nuclear sap contains nucleic acid was made as a result of our experimental findings. From this it was a short step to the hypothesis, admittedly tentative, that the spindle was a gel of nucleic acid. Let us look at these suggestions from the cytologists' point of view. According to their present conceptions the chromosomes separate from the nuclear sap, at early prophase in the form of a thread of chromosomin. The chromosomes then contract by spiralization until metaphase is reached. Evidently the metaphase chromosomes consist of compressed cylindrical spirals, the hollow interior and the interstices between the spirals being filled with nuclear sap. If nucleic acid is present in the nuclear sap this would almost certainly combine with the basic groups of the chromosomin, thereby enhancing its power to combine with basic dyes. Such a picture, if correct, renders it difficult to decide whether to regard the central core of the chromosomes as constituting part of the chromosomes or part of the nuclear sap. It was to some extent for this reason that we were careful to admit the possibility that the chromosomes contained some nucleic acid.

What evidence have we in favour of our view? In the first place we have shown that the presence of chromosomin in the chromosomes is sufficient to account for the staining properties of the latter. Even the results obtained with Feulgen's stain can, as we have shown, be interpreted on the same basis; and, if any doubt still remains about this interpretation, it is completely dispelled by the results which Dr. Choudhuri, who is presenting his evidence separately, has obtained with plant cells. Without preliminary hydrolysis he has succeeded in staining the chromosomes with "developed Feulgen reagent" as effectively as when the normal Feulgen technique is employed [see NATURE, October 23, p. 475].

Secondly, in our analytical work on the composition of various nuclei, we have accounted for practically the whole of their dry weight. This analytical work has, moreover, shown that there are only three constituents (chromosomin, histone and nucleic acid) present in the nuclei in appreciable amount. Of these, chromosomin is contained wholly in the chromosomes while histone is, in some nuclei, present in insufficient amount to form the solid matter of the nuclear sap. Only one conclusion can be drawn from this result, namely, that the solid material of the nuclear sap is nucleic acid. Can Mr. Callan suggest any alternative substance to take its place? We should add that our suggestion regarding the nature of the spindle has much to commend it. Spindle formation is an almost unvarying phenomenon in mitosis. This fact and the nature of the spindle imply that in all nuclei it is formed from an unvarying substance with the property of forming a viscous solution or gel in low concentrations. Deoxyribose nucleic acid fulfils these requirements.

The case against our suggestions is given in Mr. Callan's letter. There are a few comments which we should like to make.

(1) Mazia and Jaeger's results, contrary to Mr. Callan's opinion, support our view. They found (*a*) that the chromosomes are rapidly and completely digested by trypsin and slowly and incompletely by pepsin; (*b*) that nuclease, while it destroyed the staining capacity of the chromosomes towards acetocarmine, did so "without affecting the integrity of the chromosomes".

(2) Caspersson had previously shown that chromosomes are rapidly digested by trypsin; but because the effect was largely inhibited by lanthanum acetate he assumed that, in its absence, the nucleic acid was lost by diffusion. This conclusion overlooks the probability that lanthanum ions also render chromosomin completely insoluble and hence less readily susceptible to digestion.

(3) The use of ultra-violet spectroscopy for the identification of organic compounds is a purely empirical method, and has in the past led to incorrect conclusions even with pure substances. Considerable caution must therefore be exercised when applying the method to fixed or even untreated nuclei. Moreover, if one examines Caspersson's work critically one will find, as he himself admits, that the maximum absorption of the chromosomes does not correspond with the maximum of nucleic acid. From his diagrams the two appear to differ by nearly 100 A., that for the chromosomes being at about 2750 A. Is it a significant fact that this figure is almost identical with the maximum, as determined by Caspersson himself, for tryptophan? We ask this question because, as we have previously pointed out, chromosomin is rich in tryptophan. If both the necessary chromosomin and the requisite apparatus become available to us, we shall examine this point experimentally.

(4) Norberg's work need not be considered in detail. The author himself only regards his results as preliminary ones. While we do not wish to question the sensitivity and accuracy of his actual phosphorus determinations, we do doubt his ability to separate, by the methods he employs, the chromosomes from the nuclear sap in which they are embedded.

(5) Barigozzi's results are, in our opinion, without significance with regard to the point at issue.

EDGAR STEDMAN.
ELLEN STEDMAN.

Department of Medical Chemistry,
University of Edinburgh.
Sept. 27.

[1] Stedman, E., and Stedman, E., unpublished.
[2] Mirsky, A. E., "Advances in Enzymology", **3**, 1 (1943).

Effect of Thiourea on the Development of the Amphibian

IT has been shown recently that certain of the sulphonamides and thiourea act as goitrogenic agents in the rat[1,2,3]. These substances have been found also to lower the basal metabolic rate in normal animals[4,5] and to alleviate the symptoms of hyperthyroidism in humans[6,7] by inhibiting the production of thyroid hormone. Since the frog larva is one of the most

sensitive indicators of the presence or absence of thyroid material, it became of interest to test the effects of such compounds on the development of the tadpole.

Rana pipiens larvæ were obtained by the method of induced ovulation[6]. Upon reaching the hind-limb bud stage they were immersed in a 0·033 per cent thiourea tap-water solution and fed a diet of boiled spinach throughout the investigation. The thiourea solutions and food were renewed daily. Definite retardation of the metamorphic process was noted so early as the second week. At the end of the third month, the hindlimbs had grown to a length of only 3–5 mm. At this time most of the untreated controls had undergone completely the process of metamorphosis. Although their differentiation was inhibited, the treated animals continued to eat and increased markedly in size and weight. The body and head showed considerable broadening; the viscera were unusually large. Their appearance corresponded to that described for the thyroidectomized tadpole[9,10]. A typical animal, following two months of treatment, measured 90 mm. in total length, 33 mm. in body-length (from snout to base of tail), and had a width (across body) of 19 mm. Its weight was 5·8 gm.; its hindlimb length, however, was only 3·0 mm. None of the several hundred untreated controls employed in this study ever attained such large dimensions.

After about a month of thiourea treatment, most of the animals developed peculiar tail abnormalities characterized by a twisting and thickening confined largely to the base. This effect could not be attributed to any peculiar environmental condition other than the thiourea, since it never occurred in any of the controls kept under similar conditions.

Several tadpoles were allowed to reach a more advanced stage in development (8–10 mm. hind-limb length), and then immersed in thiourea solutions. Here the metamorphic process continued for some time, but at a much slower rate than in the controls. This advance was due probably to the continued release of thyroid substance present in the gland prior to the initiation of experimental treatment.

That the effects of thiourea are reversible was seen from our finding that tadpoles which had been treated with this substance for two months, and then returned to ordinary tap water, promptly resumed their development and became frogs in a relatively short time.

Of especial significance is the fact that the thyroid glands of the experimental animals revealed no enlargement such as has been described in the mammal. On the contrary, the thyroids of tadpoles immersed in thiourea for two months were found to be reduced in size, contained fewer follicles and showed all typical signs of atrophy (for example, low epithelium and colloid retention). Histological studies of thyroids from animals treated for shorter periods of time and with different concentrations of the drug are now being made.

Thiourea does not operate by rendering the body tissues less sensitive to thyroid hormone since we have found that thiourea-treated tadpoles immersed in a solution of thyroxine 1 in 5 million and 0·033 per cent thiourea were transformed rapidly into frogs. Likewise, it has been shown in the mammal that administration of thyroid hormone prevents the goitrogenic action of thiourea and results in a return of the metabolic rate to normal levels[4,5]. Although the evidence is suggestive that thiourea, in the developing amphibian, acts by inhibiting the formation of normal thyroid principle, the question as to whether the drug also affects the production and release of thyrotropic hormone from the pituitary is being investigated at the present time.

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Xanthine Oxidase Activity of Cow's Milk

BOOTH[1] was unable to confirm Wieland and Macrae's[2] observation that the xanthine oxidase activity of cow's milk was low when the sample was freshly drawn but underwent a spontaneous rise when it was allowed to stand in the presence of a suitable preservative. The discrepancy between the results of these workers is probably due to the fact that Booth's samples[3] had already been subjected on the farm to routine cooling, a procedure which, like shaking in air or nitrogen, is sufficient to induce a marked rise in activity[4]. By examining uncooled samples of milk, I have been able to confirm and extend Wieland and Macrae's observations. Twigg[5] kindly informs me that he also has observed the spontaneous rise in xanthine oxidase activity of samples of milk which are allowed to stand after being drawn.

The samples of milk were drawn, into sterile bottles, from Guernsey, Red Poll and Shorthorn cows over the periods December 1938 – July 1939, and March – June 1941. When cooled milk was required, the sample was divided, and one part passed over the 'cooler' within a few minutes of milking. Both uncooled and cooled samples were preserved with thymol and stored at 0–2° C.

Xanthine oxidase activity was determined by methylene blue decolorization and manometrically. In the first method, 1 ml. samples were suspended in phosphate buffer at *p*H 8·0, and allowed to react anaerobically with hypoxanthine or xanthine in the presence of *N*/1,000 methylene blue in a total volume of 5 ml. With a final substrate concentration of 0·0004 *M*., the activity was low when tested within a few hours of milking, but underwent a spontaneous rise up to the thirty-sixth hour. Some typical results are given in Table 1. Further slight rises were noted in samples retested on the third day, but subsequent increases were not observed, although some milks were retested up to one month after milking. Figures showing the increase in xanthine oxidase activity

Table 1.

Sample	10^4 / decolorization time in sec.			
	Untreated	'Cooled'	Shaken in air for 20 min.	Allowed to stand for 36 hours
A	45	159	244	250
B	39	134	196	189
C	36	139	200	222

Table 2.

Sample	Percentage fat	Activity (as in Table 1)
O-1	0·33	16
O-2	5·90	110
O-3	8·40	180
P-1	0·80	11
P-2	6·00	53
P-3	10·50	78

which occurred when the samples were cooled or shaken are also given in Table 1.

The gradual rise in activity of uncooled samples occurred with varying concentrations of substrate. Thus in final concentrations of 0·0004, 0·0008, 0·0016 and 0·0032 *M*. xanthine, one sample showed activities, expressed as (reciprocal of decolorization time in seconds) × 10^4, of 22, 21, 18 and 10, respectively, when tested eight hours after milking, and of 127, 85, 78 and 72, respectively, when retested on the third day.

In the manometric estimations, the oxygen uptake of 1 ml. samples of uncooled milk, suspended in phosphate buffer at *p*H 8·0, was determined in the presence of varying concentrations of substrate. In a typical sample, the uptake per hour per mgm. of dry matter, in the presence of 0·0008, 0·0016, 0·0032 and 0·0064 *M*. xanthine, rose from 2·72, 3·28, 3·50 and 6·24 μl., respectively, when tested two hours after milking, to 5·76, 6·88, 9·20 and 9·52 μl., respectively, when retested on the third day.

Earlier studies have suggested that, in cow's milk as secreted, xanthine oxidase is in intimate relationship with the fat globules[6,7,8,9,10]. This point was further investigated by estimating the activity of samples drawn at different stages during single milkings, in which the percentage of fat increases from a low level in the 'fore milk' to a high level in the 'strippings'[11]. The initial activity, as determined by methylene blue decolorization, was found to be directly related to the concentration of fat, as shown for two typical samples in Table 2. The spontaneous rise in activity of the samples with a high concentration of fat was marked; the 'strippings' (11·1 per cent fat) from one animal had an activity (expressed as above) of only 39 when tested three hours after milking, and one of 292 when retested on the third day.

Some of the possible explanations of the spontaneous rise in activity, namely, bacterial contamination, oxygen effect, were excluded by the experiments of Wieland and Macrae. Release of activity accompanies aggregation of the milk fat globules[4], and hence coincides with disruption of their surface membrane, a structure which appears to be composed of a complex of phospholipids and a membrane protein, different from other known milk proteins[12,9]. It seems possible that the protein bearer of xanthine oxidase forms part of this membrane, and is secreted in the spread condition, in which it might well be inactive.

Tarassuk and Richardson[13] have recently reported that the lipase activity of freshly drawn milk undergoes a marked rise when the sample is cooled to between 15° and 20° C., and it would be interesting to follow the activity on 'cooling' or standing of other milk enzymes.

I am indebted to Dr. T. F. Macrae for suggesting this work, and to Drs. V. H. Booth, Harriette Chick, J. F. Danielli and M. Dixon for their criticisms. At the time this work was carried out, I was Ministry of Agriculture and Fisheries student in animal health.

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Intracellular Symbionts of Insects as a Source of Vitamins

In our previous communication on the vitamins of the B group required by insects[1], we pointed out that the difference in the vitamin requirements of two groups of beetles, one comprising Tribolium and Ptinus, and the other Lasioderma, Sitodrepa and Silvanus, was possibly due to the presence, in the latter group, of intracellular symbionts. Tribolium, Ptinus and (unpublished) the moth *Ephestia elutella* require thiamin, riboflavin, nicotinic acid, pyridoxine and pantothenic acid, and, to a lesser degree, choline chloride and biotin as essential growth factors. Lasioderma, Sitodrepa and Silvanus grow successfully in the absence of some of these vitamins, although their requirements differ in detail. The growth of normal larvæ of *Lasioderma serricorne* and *Sitodrepa panicea* and of *Ptinus tectus* on diets containing all the chemically known factors of the vitamin B complex in pure substance (whole diet) and on diets which were lacking in one single B factor are shown in the accompanying table.

In continuation of these experiments, Lasioderma and Sitodrepa have been obtained free from symbionts by surface sterilization of the eggs (according to Koch[2]), and the vitamin requirements of the normal and the sterilized larva have been compared. It is seen in the accompanying table that the vitamin requirements of sterilized larvæ are very different from those of the normal larvæ, and in every respect resemble those of Ptinus. Sterilized larvæ of Sitodrepa grew as well as unsterilized larvæ in the presence of all the vitamins, or in the absence of either *i*-inositol or *p*-aminobenzoic acid. This indicates that sterilizing had no harmful effect provided the diet remained optimal. No growth of sterilized larvæ took place in the absence of the five important factors of the B complex, thiamin, riboflavin, nicotinic acid, pyridoxine and pantothenic acid, and little growth in the

	Lasioderma unsterilized	Lasioderma sterilized	Sitodrepa unsterilized	Sitodrepa sterilized	Ptinus
Whole diet	++++	+++	++++	++++	++++
No thiamin (B_1)	+	—	—	—	±
No riboflavin	++++	—	++(+)	—	—
No nicotinic acid	++++	—	++++	—	—
No pyridoxine (B_6)	++++	—	+++	—	+
No pantothenic acid	+++	—	++	—	±
No choline chloride	++	—	+++	+	++
No i-inositol	++++	+++	++++	++++	+++
No *p*-aminobenzoic acid	++++	+++	++++	++++	+++(+)

Efficiency of the whole diet is indicated by ++++. The whole diet consists of casein 50, glucose 50, cholesterol 1, insoluble part of yeast 5, McCollum's salt mixture 2, water 15 parts; wheat germ oil 7 mgm./gm.; thiamin, riboflavin, nicotinic acid, pyridoxine, pantothenic acid and *p*-aminobenzoic acid (50 μ gm./gm. of the dry diet); choline chloride and inositol (500 μ gm./gm.).

absence of choline, while the normal larvæ grew quite well in the absence of any of these vitamins (except thiamin). The results obtained with Lasioderma are similar, the only difference being that sterilized larvæ, in the presence of all the vitamins, or in the absence of inositol or *p*-aminobenzoic acid, grew slightly more slowly than normal ones.

It had been suggested before[2,3] that the role of intracellular symbionts in insects might be to provide accessory food substances, but this is the first experimental evidence in support of that suggestion which has yet been brought forward. Full details of this investigation will be published elsewhere.

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Germination of the Sporangia of Coelomomyces Keilin

ONE of us (J. M.) has found several fungal infections in mosquito larvæ in Northern Rhodesia. The sporangia appear similar or related to those described by Keilin[1], Iyengar[2] and Walker[3], and we tentatively relegate them to the genus Coelomomyces K. So far as we know, no previous worker has observed the germination of sporangia of the genus Coelomomyces, though Keilin appears to have had a shrewd guess as to what was likely to happen.

The sporangia, all thick-walled, which we succeeded in getting to germinate were found in a larva of a species of Mucidus (Dipt. Culicidæ). The process of germination is well shown by the accompanying photographs. A sporangium when about to germinate first loses its oil droplets and the interior becomes granular. (*a*) A slight bulge appears on one side; (*b*) the bulge enlarges, the outer hard shell ruptures and the thin internal membranes appear; (*c*) two thin membranes are now visible, and the contents of the sporangium flows out and is confined within the inner of the thin membranes; (*d*) the two thin membranes are now easily visible and are more widely separated. This, unfortunately, was the last photograph of the actual germination that could be taken. The next, and by far the most spectacular phase, was the sudden coming to life of the zoospores. Up to stage (*d*), no separate zoospores could be seen because of the close packing in the sporangium; with the extrusion of the inner membranes, however, the pressure is released and the spores come to life. Once having started to move around they gradually gain speed until the interior of the sporangium and the extruded thin membranes are a seething mass of zoospores. In a few minutes after the beginning of movement, the zoospores contained within the extruded membrane find their way out to the exterior and immediately swim out of the field of observation. More zoospores from inside the sporangium take their place, and gradually the whole empties itself and all that is left is a sporangium with a rent through which the thin membranes had extruded (*e*).

The time taken to reach the stage shown in (*c*) may be a day or two. Once the zoospores flow into the extruded thin membranes, complete liberation takes place in a few minutes. During the act of leaving the sporangium one does not gain the impression that the extruded membranes suddenly burst, because they appear to remain intact, and zoospores leave gradually as if they were capable of penetrating the thin membranes without rupturing them. The zoospores have a single flagellum. The body measures about 4 μ, and the length of the flagellum is approximately four times this length. They progress head first and the flagellum is not undulated but whipped rather stiffly from side to side.

We are indebted to Dr. S. Selby of Johannesburg for the loan of his microphotographic apparatus, which made it possible for us to make a large number of exposures with the minimum delay.

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Stereomorphism in Cryptic Coloration of Lepidoptera

CRYPTIC effect, that is, the inconspicuousness of the organism in its natural environment, depends upon three main causes: (1) the coloration of the cryptic organism should resemble that of the surroundings; (2) the body-shape is often modified to resemble environmental components (stick insects, etc.); (3) the effect is that of a quiescent organism and not of a moving one, and the attitude of rest and the bodily components are exactly adapted to each other. According to Oudemans' rule[1], the cryptic colours of resting Lepidoptera are the only visible ones, while all the bright telechromatic[2] areas are concealed. The above three groups of factors form a definite system independent in a way of other bodily systems and using the body, as it were, as a sort of substratum irrespective of its organs. The term 'cryptom' may be given to the system.

According to Thayer's principle of counter shading[3], the orderly distribution of colours is largely responsible for the effectiveness of the cryptom, the main result of the working of the principle being that the convex bodies, for example, of birds, are rendered visually flat. The cryptoms of Lepidoptera, and especially Rhopalocera, are mainly located on the wings. Because the latter are flat, Thayer's principle is not applicable to them. Using stereoscopic apparatus and the method of stereomodels, I was able to show[4] that cryptoms of this sort are governed by the principle of stereomorphism[5], that is, that on cryptic wings two-dimensional images are present, so that the relation of the flat cryptom to some hypothetical microlandscape corresponds to that of a photograph of a landscape and the landscape itself. On these stereomodels the pattern components are imitated by shadows cast by their sculptured non-coloured surface (see illustration). The relief of the latter may be very complicated according to the cryptom copied, and consists of a number of raised and lowered areas which are generally curved and often pass into one another by gentle alterations of their directions and inclinations.

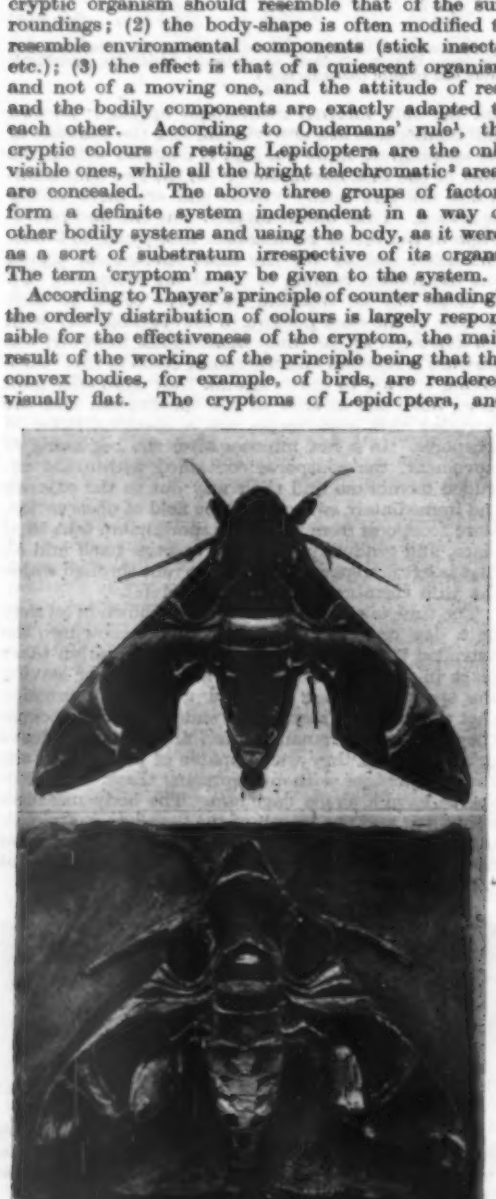

Fig. 1. (Above): A SPECIMEN OF THE HAWK MOTH, *Daphnis nerii* L. (Below): A CLAY MONOCHROME MODEL OF THE ABOVE MOTH IN WHICH THE COLOUR PATTERN IS IMITATED BY THE DISTRIBUTION OF SHADOWS ON THE SCULPTURED SURFACE OF THE MODEL. THE METHOD PROVES THAT THE COLOUR PATTERN OF THE MOTH REPRESENTS A TWO-DIMENSIONAL REPRODUCTION OF HYPOTHETICAL THREE-DIMENSIONAL BODIES. DUE TO THIS, THE CRYPTIC EFFECT OF THIS SORT OF COLORATION IS VERY STRONG.

But in Cott's excellent book[6] the above models are described as consisting of "different surfaces lying in the same plane but on different levels", and it is argued that the surfaces in question should be regarded as sloped and curved. My paper is illustrated by the model of *Erebia lappona* chosen as a very simple example of the method and consisting as a matter of fact of flat surfaces. But in the text, "protuberances and depressions of different shape and size" seen through stereoscopic devices are spoken of, and mention is made of the model of *Daphnis nerii* illustrated in the accompanying figure. This model consists of a number of variously sloped surfaces, many of them being curved. It was exhibited at a scientific meeting in 1939 and the photograph published in 1941[5]. The basic idea of the research in question is "that the wings of moths and butterflies imitate bark, leaves and the like"[4]. Because the typical surfaces of objects of this sort are curved, the surfaces of models could not be restricted to flat shapes. The latter should be regarded as a particular example of a surface normally curved. Thus Dr. Cott's interpretation of my models and my own view are at variance.

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Binucleate Oidia on Binucleate Mycelium of *Polystictus hirsutus* Fr.

BRODIE[1] remarked that the occurrence of binucleate oidia on binucleate mycelium of basidiomycetous fungi is rare. The only example cited so far seems that of *Pholiota aurivella* Batsch by Vandendries and Martens[2].

While carrying on pairing experiments with closely related species of Polypores on agar films on slides, I came across an oidial strain of *Polystictus hirsutus* which is heterothallic and bipolar[3]. This was paired with *Polystictus steinheilianus* Berk. and Lev. (a non-oidial one). Binucleate oidia in four or five short chains arising direct from binucleate hyphæ of *P. hirsutus* with clamp-connexions were obtained close to the line of demarcation between polysporous cultures of the two closely related species, and there

was a number of hyphal fusions between hyphæ of *P. hirsutus* and *P. steinheilianus* at the line of demarcation. Farther away from the line, monocaryon oidia in short chains like the fingers of the human hand were found due to haploidization of the binucleate hyphæ of *P. hirsutus*, no clamp-connexions having occurred on the oidial hyphæ. In single (polysporous) culture of *P. hirsutus*, only monocaryon oidia were obtained, as noticed by Brodie in dicaryon mycelium of *Collybia velutipes*. So the presence of binucleate oidia in this case may be ascribed to the influence of pairing of *P. steinheilianus* on *P. hirsutus*.

For the observation of nuclei in oidia the agar-films were fixed in Allen's bouin and stained with Haidenhain's iron-alum hæmatoxylin. Dicaryon oidia were cylindrical while monocaryon oidia were oval.

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A Case of Club-Root of Swedes Due to a Seed-borne Infection

CLUB-ROOT caused by *Plasmodiophera brassicæ* Wor. is one of the most serious diseases to which cultivated Brassicas are subject. The disease usually results from the planting of susceptible crops in contaminated soil, and the general assumption is that the infection is contracted from the soil. So far as I am aware, the relevant literature contains no record of an outbreak of the disease traceable to the use of contaminated seed. Three outbreaks of the disease which occurred in 1942 and 1943 in a Manchester garden could not, however, be traced as being due to a soil contamination. A survey of all attendant circumstances showed no previous Plasmodiophera history in the immediate locality or contributory circumstance by which it could have been introduced into the garden, and the evidence pointed to a seed-borne infection.

As a small quantity of seed which had given rise to a diseased swede crop was available, experiments were carried out, designed to show, if possible, whether or not the disease had been seed-borne. If, in fact, the seed was infected, then a surface contamination with infected soil resulting from contact of the fruit with soil either before or during harvest was suspected, and the experiments were made with this possibility in mind. All sowings were made in boxes of compost and all the compost components and the containers were effectively sterilized. Fertilizers were added to the mixture as recommended for John Innes compost but no lime was added.

For each variety, one box was sown with untreated seed and one with seed 'surface sterilized' with hypochlorite. As controls, two boxes of Cambridge No. 5 Brussels sprouts were used. The Brussels sprouts seed had previously given disease-free plants. Two further boxes of Brussels sprouts were sown and immediately after sowing watered with swede seed washings obtained by soaking the swede seed in distilled water over-night.

Seed was sown on July 22. Germination was good in all boxes, and the seedlings grew satisfactorily. By mid-September some of the swedes had developed swellings at the bases of the hypocotyls and typical clubbed roots; in the cells of which numerous plasmodia of *P. brassica* were present. All the plants were harvested and minutely examined on October 1, and the data obtained are assembled below:

	Total number of plants	Per cent infected
Swede, var. Best-of-all		
Untreated seed	40	52·5
Surface sterilized seed	46	41·3
Brussels sprout with Best-of-all swede seed washings	27	0
Swede, var. Conqueror		
Untreated seed	45	15·6
Surface sterilized seed	63	1·6
Brussels sprout with Conqueror swede seed washings	30	16·7
Brussels sprout		
Untreated seed (1)	42	0
Untreated seed (2)	63	0

The small amount of seed available precluded the carrying out of any more elaborate experiments, but the results obtained point clearly to the disease in the swedes being seed-borne. Further, the results obtained are entirely explicable if there is surface contamination of the seed; and surface sterilization of the seed with hypochlorite is no more, or not much more, effective in removing this than washing with water alone. Whereas the contamination of the Conqueror swedes is easily removable, that of the Best-of-all swedes is more adherent, with the result that while Conqueror seed washings cause infection of Brussels sprouts, the Best-of-all seed washings fail to do so. The conclusion that the disease is seed-borne and in one case at least (and probably in both) due to surface contamination appears inescapable.

Having established that club-root may appear in brassicas because of a seed-borne infection, some points of considerable importance are raised.

To determine what proportion of new outbreaks of the disease is in fact due to this cause is well-nigh impossible as so rarely is suspected seed available for experimental purposes. Nevertheless, even if the proportion is small and the risk of introducing the club-root organism into clean ground by this method remote, the development of suitable methods of seed sterilization may be worth while, while the importance of growing brassica seed crops only on clean land is clearly indicated.

I am indebted to Dr. H. J. Western for confirming my identification of *P. brassica*.

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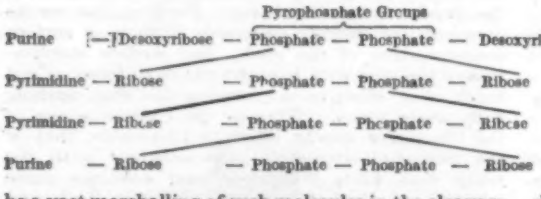
A Speculation on the Nature of the Chemical Structure which is the Essence of the Malignant Cell

ALTHOUGH it must be presumed that the chemical constitution of the cancer cell diverges in some subtle yet profound manner from the non-malignant, up to the present definite suggestions as to the manner of this difference have not been formulated in terms of atoms and molecules. Thus evidence for abnormal respiratory exchange has been adduced by many

investigators and rebutted by other workers; the secret of malignancy has been attributed to chromosome abnormalities, to gene mutation, lack of hormone balance, irregularity of enzyme constitution, etc.

The concept submitted below is possibly little more than an integration of current ideas, but it is set forth because this simple chemical aspect has stimulated us to what we believe to be intelligently planned if, thus far, unfruitful experiments. It may occasion useful criticism and clarification by others who can bring to bear upon it diverse aspects of knowledge.

The essence of the idea is the formulation of a molecule in the chromosome capable of splitting into two similar symmetrical portions. Visualization of the severance of this molecule during division of the chromosome gives a picture of the vital process of reconstitution of this most important nuclear material in each 'daughter' cell. Further, in the case of the malignant cell, the molecule is to be conceived as impelled on a course of irreversible division. In the chromosome itself, no doubt associated with other nuclear constituents, there would


Pyrophosphate Groups
Purine
[—]Desoxyribose — Phosphate — Phosphate — Desoxyribose — Purine
Pyrimidine — Ribose — Phosphate — Phosphate — Ribose — Pyrimidine
Pyrimidine — Ribose — Phosphate — Phosphate — Ribose — Pyrimidine
Purine — Ribose — Phosphate — Phosphate — Ribose — Purine

be a vast marshalling of such molecules in the cleavage plane. The specific molecule envisaged is a nucleic acid linked through pyrophosphoric acid to nucleotide groups.

There is much evidence that compound nucleotides, some of them exhibiting this pyrophosphoric group, are of great importance in cellular processes, for example, co-dehydrogenase I, thiamine pyrophosphate (co-carboxylase), riboflavine-adenine dinucleotide, and phosphagen, while the active principle of embryonic extract which promotes growth of cultured tissue, and possibly the milk factor of inherited mammary cancer in mice, may possess this structure. Consideration of the behaviour of viruses, which have attributes of a living organism and of a pure chemical, gives support to such an idea. It has been suggested that when such an entity multiplies, it does so by laying down a copy of itself on a 'template' system.

We suggest, then, that in the 'resting' phase, that is, when engaged in ordinary cellular activities, the cell has, as its essential basis, molecules of nucleic acid joined by pyrophosphoric linkings to nucleotides similar to those mentioned above which subserve its normal metabolic activity. When cell division is about to take place the metabolic nucleotides on one side of the linkage are replaced by, or are converted into, nucleotides which are the mirror image of those on the primary nucleic acid portion. The symmetrical, double nucleic acid then splits, with resultant division of the chromosomes accompanied by the associated phenomena which comprise 'cell division'.

In the case of the malignant cell, however, we would postulate that because of the abnormal juxtaposition of specific side chains, or the presence of abnormal linkings in such groups, the symmetrical development of the dual nucleic-acid molecule proceeds directly and continually instead of via the usual attachment of the metabolic type of nucleotide groups.

The factors determining the abnormal production of nuclear material might, therefore, be various, that is to say, any of the agencies which we term carcinogenic; for example, the effects occasioned by the chemical or physico-chemical attachment of the well-known carcinogenic chemicals or their reaction products, by radioactive elements, X-rays or light waves, or more directly by a virus which in itself is a compound tetra-nucleotide which undergoes division with little 'metabolic' activity.

On this hypothesis the rapidity with which a virus may induce tumours in certain organisms compared with the slow influence of pure chemicals and hormones would be explicable, while the apparent anti-cancer influence ascribed to some vitamins of the B complex and also the role of co-carcinogens could be interpreted in terms of chemical structure. The disappearance or alteration of normal cell function in many cases could also be inferred, while the occurrence of simple tumours and various grades of malignancy can all be comprehended as governed by such a mechanism operating through the pyrophosphoric di-nucleic acid structure.

Recently Stedman and Stedman[1] have described a protein component of cell nuclei present in much greater proportion than nucleic acid, but the discovery does not necessarily overthrow the belief that nucleic acid is the master constituent. The chromosomin moiety may play a most important part in providing the requisite environment for the elaboration of the 'double' nucleic acid.

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Birmingham, 15. Sept. 29.

[1] Stedman, E., and Stedman, Mrs. E., NATURE, 152, 267 (1943).

Flinders Petrie's Racial Types

IN 1887, the British Association published the report of a committee which had enabled the late Sir Flinders Petrie to photograph and make casts of a large series of 'Racial Types' from Egyptian wall-reliefs and frescoes. A limited edition of prints was published and has become very rare. In the report of the committee it was stated that the negatives were deposited with Mr. Browning Hogg, 75 High Street, Bromley, Kent, who would supply prints. It has been ascertained that Mr. Hogg ceased to live in Bromley after 1888; but the Association has no record concerning the negatives subsequent to 1887. It is now desired to trace them if by any means possible, since a number of these 'Racial Types' either are not included in Max Burchardt's series (*c.* 1913) or are much better photographs, and no later work of this nature has been done. The Association will be grateful for any information.

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RESEARCH ITEMS

The Naivasha Fossil Skull and Skeleton

THESE interesting remains were excavated by Dr. L. S. B. and Mrs. Leakey in July and August 1940 from a very rich prehistoric site at the base of a cliff a few miles from Naivasha (*J. E. Africa Nat. Hist. Soc.*, **16**, 169; June 1942). Most of the skeleton was *in situ*. A large number of artefacts, mainly obsidian implements and fragments of implements, was found in the same silts. This associated industry somewhat resembles that known as Upper Kenya Aurignacian Phase "C", but may prove to be a slightly later date, as yet unnamed. The relationship of this Naivasha skull and skeleton to other East African prehistoric skulls is not at all easy to determine. Leakey's conclusion is that it probably resembles a male of *Homo sapiens* type, and is dated as belonging to the closing phase of the Gamblian Pluvial, after the second maximum of that Pluvial had passed. The skull is long and very narrow, with the very low cranial index of 64·52. The type represented has no very close affinity to any other prehistoric types from Kenya, though it bears a certain resemblance to the Oldoway skull from Tanganyika Territory, which is also attributed to the closing stages of the Gamblian Pluvial and is probably connected with a late stage of the Upper Kenya Aurignacian culture.

Density of Certain Marine Organisms

INTERESTING data that throw light on the relationship between certain marine organisms and their environment and mode of development are reported by A. G. Lowndes (*Proc. Zool. Soc.*, Ser. A, **113**, 28; 1943). In decapod Crustacea the resting ovaries have a density approximating to that of protoplasm (1·0565) but the ova have a much higher density (1·1129 for *Maia squinado*), and the early embryos are so dense (1·1170) that they would be unable to swim and to lead an independent life. They possess an appreciable store of food and are carried by the females; they become free-swimming only when their density has fallen. In the copepods, when the zygotes are extruded there is a great increase in volume due to water absorption and a corresponding decrease in density, so that embryos of low density and capable of an independent existence result. The data for the Echinodermata are fewer, but they show that in four species, as the ova develop, their density decreases, so that the early embryos have such a low density that they can be supported in the water by their own cilia, and this obviates the necessity of a large food store in the ova and of carriage by the females, and permits the early assumption of a free-living habit.

Fishes from the Phœnix and Samoan Islands

LEONARD P. SCHULTZ reports on a large number of fishes from these islands, collected in 1939 during the Navy Survey Expedition of the U.S.S. *Bushnell*, to which he was attached as naturalist (U.S. Nat. Mus. *Bull.* 180, 1943). This unique opportunity for securing rare and interesting material resulted in the capture of an enormous number of fishes, upwards of 14,000 being collected, with about 3,000 specimens of other groups. Thirty new fishes belonging to six new genera are described and many new records are given. There are useful keys to species, and, in some cases, to genera and families; and the report is illustrated by diagrams, figures and plates. Valuable colour notes are included, taken at the time of collection. Among the larger fishes the order Apodes is well represented, the genera belonging to six families, seven species being new. Of the smaller fishes there are many gobies, including thirty-four genera. The report is purely systematic and no notes relating to the natural history of the different fishes are given.

Interspecific Translocation of a Chromosome Arm

A. HÅKANSSON (*Hereditas*, **29**, 141; 1943) has examined the progeny of a hybrid between *Godetia Whitneyi* and *G. deflexa* created by Hiorth. By repeated back-crosses a red-nerved plant with fifteen chromosomes was obtained which produced a large deficiency of red-nerved plants in its offspring on crossing to normal fourteen-chromosome *G. Whitneyi*. The extra chromosome presumably carrying *R* for red-nerves was eliminated during meiosis. By X-raying such red-nerved plants Hiorth found a plant which segregated fifty-five red-nerved to sixty-four normal plants, that is, almost equality. Håkansson found that this plant has fourteen chromosomes and forms bivalents regularly, but that one pair of bivalents was heteromorphic. There is no sign of pairing of the longer arm of one member of this bivalent and it presumably was derived from *G. deflexa*, whereas the rest of the chromosomes were derived from *G. Whitneyi*.

Silver Compounds as Fungicides

THE toxic action of silver compounds for certain fungi has been known for a considerable time, but the high cost of silver and the awe of its being a precious metal doubtless inhibited any extensive exploitation of its fungicidal properties. Lowell W. Nielsen, however, has made extensive tests of silver compounds as the toxic agents for spray fluids (Memoir 248, Cornell Univ. Agr. Exp. Sta., Ithaca, N.Y.; November 1942). The trials were all made in an inoculation chamber, using the potato and *Phytophthora infestans* as the host and parasite respectively. Several silver compounds and mixtures gave promising results, the best being a combination of silver nitrate, ferrous sulphate and lime in the approximate proportions 15 : 25 : 15, and diluted with water to a strength of 100 p.p.m. of silver. This mixture had also satisfactory adhering qualities. The experiments are part of the search for a spray fluid which would be less harmful to certain kinds of foliage than those commonly used. They establish the most useful mixture, but do not yet include field trials, or any economic evaluation, though the estimated cost for materials of about one cent per gallon of spray fluid does not appear excessive.

Chemical Evolution of the Ocean

E. J. CONWAY has discussed in illuminating detail the principles governing the composition of ocean water and its variation during geological time (*Proc. Roy. Irish Acad.*, **48**, B, 9; 1943). The main hypothesis is based on the assumption that the ocean volume has remained essentially constant, with additions of chlorine either from the original atmosphere or from volcanic sources. A subsidiary hypothesis based on the idea of a growing ocean fed by juvenile water is more briefly treated. It is shown that the removal of potassium from the ocean by living organisms, with subsequent conversion to glauconite, has played a major part in the chemical

evolution. A noteworthy effect which may be correlated with the large-scale appearance of fossils in Cambrian time was to bring about a marked increase in the concentrations of calcium and magnesium ions and a corresponding decrease in the sulphate concentration. The oceanic composition of the early Ordovician period—about the time of the first appearance of vertebrates—is compared with the composition of mammalian blood plasma. The oceanic salinity was then about three times that of such plasma and had a different composition pattern, particularly with respect to calcium and magnesium. It is pointed out that the apparent discrepancy between the age of the ocean as measured by chemical denudation and that of the oldest rocks dated by radioactive methods tends to disappear when account is taken (*a*) of sodium deriving from rock silicates alone, and (*b*) of present-day factors which lead to abnormally high rates of denudation. The paper is highly original in methods and fruitful in results, and deserves careful study by all who are interested in the geochemical history of the oceans.

Erratics of the Cambridge Greensand

It is well known that the Cambridge Greensand has yielded a great variety of erratic pebbles and boulders. L. Hawkes has made a careful study of the collection of 163 erratics housed in the Sedgwick Museum, Cambridge (*Quart. J. Geol. Soc.*, 93–104; 1943). About forty different types of sedimentary, igneous and metamorphic rocks have been recognized. Two boulders may be matched with the paisanite of Mynydd Mawr, North Wales; others with the Uriconian rocks of the Midlands and Welsh borders; but the majority, two of which are of types unknown in the British Isles, cannot be localized. The boulders were floated to the Cambridge region, probably in the roots of trees, during the period of formation of the Greensand deposit. They prove that land existed at this time in North Wales and adjoining areas, probably as a peneplain of Lower Palæozoic and Pre-Cambrian rocks diversified with monadnocks such as Mynydd Mawr. The prevailing currents appear to have been from the west, and it is surmised that nearly all the erratics could have been derived from land in this direction, with Northern Ireland as a probable source for the schists and gneisses of the collection.

Sub-Crustal Structure of New Zealand

The structure of the earth's crust immediately beneath New Zealand has recently been investigated by R. C. Hayes ("The Subcrustal Structure in the New Zealand Region from Seismic Data", by R. C. Hayes, *Bull. Seismological Soc. Amer.*, **33**, No. 2, April 1943). The author states that it has become evident from recent investigations that there is some definite arrangement in the distribution of earthquake origins in the New Zealand region. Earthquakes originate below normal depth in many parts of the region, depths of several hundred kilometres occurring beneath the volcanic zone in North Island. Depths of focus have been plotted. The results seem to show the existence of a discontinuity of more or less regular form, its depth varying from about 30 km. in some places to a maximum of more than 350 km. It is suggested that the material below this discontinuity is so viscous as to have been distorted by plastic flow into folds, the most marked one having its crest along the east coast of North Island from near East Cape to south of Cook Strait. Its slope appears to be very steep toward the north-west. Above the discontinuity earthquakes occur, and recent major shocks at various points near the crest of the fold suggest that it continues to be forced upward, causing fracture and fault-slipping in the more brittle material above.

Synthesis of Succinic Acid

A new synthesis of succinic acid ($-CH_2COOH)_2$ is reported by M. S. Kharasch and M. T. Gladstone (*J. Amer. Chem. Soc.*, **65**, 15; 1943), in which acetyl peroxide dissolved in glacial acetic acid is dropped slowly into glacial acetic acid maintained at 95°–100°. A mixture of methane and carbon dioxide is evolved. The acetic acid was removed by distillation in vacuum and the residue when crystallized from water gave succinic acid. With *iso*butyric acid, tetramethylsuccinic acid was obtained, and with chloracetic acid, *meso*-dichlorosuccinic acid. It is supposed that a free radical mechanism is involved:

$$(CH_2CO)_2O_2 = CH_3\cdot + CH_2COO\cdot + CO_2$$
$$CH_2COOH + CH\cdot = \text{complex} = CH_4 + \cdot CH_2COOH$$
$$2\cdot CH_2COOH = (-CH_2COOH)_2.$$

Flow of Viscous Fluids

About the problems of fluid flow which commonly arise in engineering practice a large amount of information has been collected by experimental methods. In six notes (A. Fathy, S. Bishara, S. A. M. Hassanein, Physical Department Paper No. 44, Government Press, Cairo, 1943) the theoretical aspect of these problems is approached by methods which differ from those usually adopted both in respect of the mathematical statement and of the empirical simplifying assumptions. The notes comprise: analysis of motion in natural co-ordinates (streamlines and their orthogonal trajectories); critical state of flow (particularly in channels); non-uniform flow in open channels; frictional conditions and velocity distribution in turbulent flow; flow through circular pipes; breakdown of the laminar state of flow.

Photovisual Magnitudes of Double Stars

A. W. J. Cousins has a paper with the above title (*Mon. Not. Roy. Astro Soc.*, **103**, 3; 1943) which describes the measurement at Durban Observatory of photovisual magnitudes for 119 stars in the southern hemisphere. Fabry's method, which was used very successfully by the late E. G. Williams and H. Knox-Shaw, at the Radcliffe Observatory, Pretoria, to determine the magnitudes and colours of *O*- and early *B*-type stars south of −35° declination, was adopted, but in the present case stars of all spectral types are included. A full description of the apparatus which was used is given, and there are tables showing the results obtained. The standards used for the determination of the zero point were the photovisual magnitudes of eight of the brighter stars of the Pleiades, which Calder obtained in 1937. When reduced to the Harvard photovisual system it was found that there existed differences of scale and zero point and also a large colour coefficient. After applying certain corrections for atmospheric extinction (a serious source of error in employing Fabry's method for this class of work), the mean deviation between the two series is ± 0·09 m. On comparing the results with 11 *B*-type stars which were also observed by Williams, the mean deviation was found to be only ± 0·025 mag.

CULTURE AND MANUAL SKILL

By C. W. HANSEL

A CRITICAL analysis of the traditional classical education in Britain reveals in many of its protagonists a narrow and prejudiced outlook, almost a pride in ignorance of science, and a contempt for manual skill. They seek to apply to the social problems of to-day a strangely perverted form of what they regard as the best ideas and practices of Greek times. Their choice and adaptation have been unfortunate, because much that is worthy of imitation has not been followed, and a great deal of inferior substitution has been made. Traditional classical education lies nearer to scholasticism than Hellenism. It is unbalanced in its blindness for everything except book learning, and it is dangerously inadequate in that it ignores the many and only partially caters for the few. Further, it is apparently unaware of the complete transformation of civilization which has resulted from the progress of science, industry, and the arts.

Sir Richard Gregory has said, "There has always been a lag between stages of scientific knowledge and social or moral wisdom. What is particularly needed to-day is to promote public interest in the close relationships of natural science with other humanistic studies which influence the thoughts and actions of all citizens."

The education of the Greek, at the time of Plato, consisted, up to the age of about seventeen, of very simple instruction in the three *R*'s, music, and dancing or gymnasium. Then followed a period of compulsory public service from seventeen to twenty. If worthy of further education, from twenty to thirty he studied mathematics and science, but not to the neglect of public duty. Philosophy was reserved for later life. There is much that is attractive in this system. There is no forcing of the pace, but a natural growth of the mind. There is an insistence on national service from everyone. There is recognition of education as a life-long process, schooling being merely part of it. Education is cultural not vocational, the one object of leisure. There is the exclusion of abstract and philosophical discussion from the education of those lacking maturity and experience. There is an immense and just appreciation of the mother tongue. Only two matters call for criticism: the undue emphasis on memory and the veneration of warlike pursuits: "Pallas I celebrate, sacker of cities, terrible goddess of war" (Aristophanes).

How has Greek education been modified in the traditional classical education of Britain? Every desirable feature of the Greek system has been changed or eliminated and almost every undesirable feature of scholasticism has been retained. The school retains the seclusion of the monastery; it is usually unconnected with home life and with the community in which the pupil will afterwards live his life. Far too much is attempted for the mind of the young pupil to expand naturally, with the result that the English language and literature are neglected in the attempt to cover excessive detail in a multiplicity of subjects by sheer memorization and imposed instruction instead of naturally acquired knowledge through the medium of concrete experience and self-instruction.

One of the most serious defects of classical instruction is the contempt it breeds for manual skill. This is one of the legacies of Greece and Rome. Archimedes is not mentioned in the twelve volumes of Grote's "History of Greece" or the eight volumes of Thirlwall. Quoting from the Langhorne translation of Plutarch's "Lives": "Eudoxus and Archytas who gave a variety and an agreeable turn to geometry, and confirmed certain problems by sensible experiments and the use of instruments, which could not be demonstrated in the way of theorem. . . . But when Plato inveighed against them, with great indignation, as corrupting and debasing the excellence of geometry, by making her descend from incorporeal and intellectual corporeal and sensible things and obliging her to make use of matter, which requires much manual labour, and is the object of servile trades; then *mechanics* were separated from geometry, and being a long time despised by the philosopher, were considered as a branch of the military art." "Archimedes . . . considered all attention to *mechanics*, and every art that ministers to common uses, as mean and sordid, and placed his whole delight in those intellectual speculations, which, without any relation to the necessities of life, have an intrinsic excellence arising from truth and demonstration only."

Quoting from a Royal Institution lecture by Prof. Benjamin Farrington: "'What are called the mechanical arts', says Socrates, 'carry a social stigma and are rightly dishonoured in our cities.'" "The word surgery is, of course, simply the modern form of the Greek cheirourgia, which means manual operation. And we shall find reason for connecting the decline of anatomy after Galen with the ancient prejudice against the cheirourgos, the surgeon or manual operator." "That the Greeks early acquired a contempt for manual labour is certain. 'The noble are those who have escaped the yoke of manual labour' (Herodotus)." "'The sick in our cities', writes Plato in the *Laws*, 'are of two classes, the slaves and the free.'" "Theirs were the crafts which Aristotle defined as being necessary for the existence of the city but as disqualifying their practitioners from citizenship."

The denial of culture to the craftsman is surely born out of an entirely unbalanced education and a completely mistaken and narrow view of culture. Culture proceeds from all those activities of mind and body that are worthy of cultivation. Matthew Arnold once said "culture unites classes"; this can scarcely refer to a state of mind which fails to recognize the dignity and worth of labour and manual skill.

Sir Richard Livingstone in "Education for a World Adrift" (see NATURE, May 8, 1943) speaks of "spiritual values" and the "noble ideals of Hellenism". The "Age of Science" he identifies with an "Age without Standards". He finds in Greek literature (even in translations) a "philosophy of life" not to be found elsewhere. Does he prefer the inhuman recital of strife, intrigue, and cruelty, for example, in Plutarch's "Lives" to what youth may learn from Smiles' "Lives of the Engineers"? Does he prefer to dwell on "the torture of the boat" rather than on the work of Lister or Pasteur? He asserts that science is non-moral and unconnected with standards of value. Has he read the second Huxley Lecture of the Anthropological Institute, by Francis Galton (see NATURE, Oct. 29, 1901)?

Sir Benjamin Brodie, in an address to the Royal Society (1859), said: "Physical investigation, more than anything besides, helps to teach us the actual value and right use of the Imagination—of that

wondrous faculty, which, left to ramble uncontrolled, leads us astray into a wilderness of perplexities and errors, a land of mists and shadows; but which, properly controlled by experience and reflection, becomes the noblest attribute of man; the source of poetic genius, the instrument of discovery in Science, without the aid of which Newton would never have invented fluxions, nor Davy decomposed the earths or the alkalies, nor would Columbus have found another continent."

Only one defect of classical instruction has been discussed. There are several others. The philosophical speculations of traditional Hellenism and the mechanical memorizing and formalism of medieval scholasticism have dominated educational schemes for centuries. Such a system of instruction has been tried and found wanting—it has masqueraded under the name of education. Let our educational aims be more worthy and appreciative of our glorious English literature, more adapted to human needs, and a study of Christian rather than pagan principles. The English language and literature, together with the arts and sciences (including mathematics) and the cultivation of a sound body, provide the basis of a complete and balanced education and a generous culture.

RHEOLOGY IN THE TEXTILE, LEATHER, SHOE AND ALLIED TRADES

AT a meeting of the British Rheologists' Club, held at Loughborough College on September 18, papers were read by Mr. A. Pollard, Dr. C. A. Maunder Foster, Mr. A. March, Mr. P. Danby and Mr. P. Stanley Briggs, and there was a discussion under the general title of "Rheology in the Textile, Leather, Shoe, and Allied Trades". It is convenient to deal with the proceedings in sections.

Textiles

In weaving, two banks of multiple warp threads are opened ('shedding'), a shuttle holding a single weft thread is passed through the 'shed' ('picking'), and a comb-like reed forces the weft into place ('beating'). The next 'shedding' operation locks the weft into place. Small inaccuracies in these three locating operations are, with staple material, partially corrected by the hairy projections from the yarn. With a smooth yarn such as rayon, which is solid rather than tubular, better location is needed; and the low 'tenacity' of the material calls for less alteration of stress than occurs in the normal 'broadcloth' loom.

In one modern ribbon loom, attention was given to these matters; warp tension was kept constant (the healds moving over the arc of a circle, centred at the line of the weft), the beating reed was given a very low amplitude, and all moving parts of the machine were very exactly controlled. Besides giving accurate and reproducible weaves, the output-rate of this machine is of the order of 1,000 'picks' per minute, or some 4–5 times normal speed of production.

A poor view was taken at the meeting of the engineering ability of many designers and builders of textile machinery in general. One assertion was made, that 'tenacity' of yarn (breaking strain in ounces per denier) does not necessarily measure its probable behaviour in weaving.

Shoemaking

Great use is made of stitching: upper construction; joining of lining to upper, of upper to insole, of insole to welt, and of welt to outsole. Each of these operations is alike in outline; but as each unit process of the stitching differs according to the particular job, a whole range of machine designs, of awls, needles, shuttle threads, and of sewing threads is required.

For lubricant, the hand cobbler uses beeswax; shuttle threads are waxed; sewing threads are rosined; and the material which, in the making operation, acts as lubricant, after cooling down seals the holes and preserves the threads.

In toe, and in heel, reinforcement is used. For this purpose the toe 'puff' may be shoddy cloth, sized with pitch or pyroxylin; or, for miners' boots, it may be steel. The toe-cap, puff reinforcement and lining must suffer the drafting strains of pulling on to a rigid wooden last; and thereafter must retain shape, and hold together as a unit.

The stiffener for the heel part is required to be rigid at its meridian, thin and flexible at its top edge.

After the shoe has been lasted, there is a hollow space under the middle of the insole; this must be suitably filled with a composition having resilience, before the outsole can be sewn or stuck on. Thus, the foundation of the average shoe is a 'sandwich' of leather insole, cork composition or felt filler, and leather or rubber outsole. Should the filler be too soft, it will shift under the pressure of the foot, to give lumps and hollows in the insole surface which will be uncomfortable in wear.

Resilience, deformability, flexibility and the like are most often judged by the test of the trained finger-and-thumb. It would be desirable to have an artificial digital assembly, not subject to fatigue (or to prejudice), for these purposes.

In the operation of shoe-building, rubbery adhesives are largely used. The processes are repetitive, mechanical, and output is very large (the standard figure for the United Kingdom is rather less than 100 million pairs annually).

The adhesive maker needs, therefore, to maintain a steady consistency in his products; and this task is not simple with some of the present-day materials. For example, with a falling sphere viscometer, a thick paste of reclaim rubber solution may appear to have both thixotropic and dilatant properties. In a case such as this, trials were made, using a rotation viscometer, to obtain a consistent reading, so that a method might be available for works use. Rotation times were taken with different loads, after various periods of stirring. Constant time for a single turn was attained in a typical experiment on a Stormer instrument, after sixteen turns. Provided the load was above a certain lower limit (2 kgm.):

Load 2·1 kgm.	after	1	2	4	8	16	32 turns
Time of single turn (sec.)		36	26	21	16	10	10

Restoration of the system to the former high viscosity figure could not be completed: after 100 hours it was still slowly increasing, in linear fashion.

For measurements on this kind of stuff, the torsional viscometer was recommended as more suitable.

Leather Finishes

The last treatment of leather, prior to sending to the warehouse, is to apply pigmented and dyed dressings or colourless seasons to the front surface (which is normally the grain side, but sometimes is the flesh side). The finishes used for this effect should have properties approximately the same as the surface layers of the leather to which they are bonded.

Some 50 per cent of the leather substance is animal protein in nature; the rest being added material of diverse origin. Animal protein likewise forms the main basis of leather finishes; with wax, shellac, pigment, grease and sulphated oil as the other ingredients, all dispersed in water.

So that the behaviour of the finishing materials under strains of the sort to which leather is subject might be studied, isolated films were stressed to the break-point. These films, between 10 μ and 15 μ thick, were cast on a rubber substratum, conditioned some days at 70 per cent relative humidity, and test pieces cut and stretched at a steady rate. Typical figures were:

	Casein	Shellac	Casein 4 : Shellac 1	Casein 4 : Wax 1	Casein 9 : Pigment 1
Elongation % at break	75	65	125	75	75

Casein plasticized with sulphated oil

	1%	2%	4%	8%
Elongation % at break	230	250	310	350

The optimum figure was got with 6 per cent plasticizer.

Several other forms of behaviour of leather finishes have to be controlled; partly in the formulation, and partly in the mode of application and after-treatment. These properties include gloss, hardness, colour, flexibility and 'feel'.

One of those present doubted the applicability of test results on continuous films; when the same material after application to the leather forms a largely discontinuous film. It was also asserted that pigment particle average size (say, 2 μ) is unimportant; the deciding (adverse) factor being the proportion and size of the larger aggregates of pigment. These, giving rise to marked localization of subsequent strains, might cause low adhesion and a brittle finish.

Leather Making

In the course of the conversion of raw animal hide into leather—soaking, liming, bating, tanning and so on—the aim is to control the closeness or openness of texture ('angle of weave'), the breakdown of reticular tissue, and the splitting (into 'fibrils') of the fibre-bundles.

Picturing the structure of leather as a trellis-work (in three rather than two dimensions), a closely-knit trellis, with high 'angle of weave', would be seen to present a compact collection of fibre-ends at the boundaries of the material. This was desirable where abrasion resistance is needed, as in sole-leather; and such a system is not readily deformable, and has elastic rebound. Close texture, coupled with considerable fibre splitting, would yield a somewhat more deformable material, as for example shoe upper leather.

In sole leather, the tannage is not pushed very far, and much filling material ('non-tans') incorporated; the grease content being small. In upper leather, the combined tan is higher, with less filler, and the texture internally lubricated with much grease. A tabular comparison is as follows:

	Sole leather	Upper leather	Belting leather
Angle of weave	high	high	low
Fibre splitting	slight	marked	marked
Tan %	18	24	24
Non-tan %	33	7	14
Grease %	3·5	17	11·5

These data related to vegetable tannage.

The chemical processes of the tannery, and the sundry mechanical treatments, can be so controlled that only one factor remains out of the tanner's reach. Until the animal can be so bred and reared as to produce a standardized pelt, this last factor would most likely continue to be an independent variable.

C. A. MAUNDER FOSTER.

MARINE BIOLOGICAL RESEARCH IN SOUTH AFRICA

THE first of a series of pamphlets to be published by the Research Survey Committee of the Association of Scientific Workers of Southern Africa has recently appeared*. The work of the Committee is "intended to help in stimulating and developing research in the Union and in affording constructive suggestions for building up a more adequate and satisfactory organisation of research within the country". Dr. Wm. Edwyn Isaac, the writer of the present pamphlet, is on the staff of the Government Low Temperature Research Laboratory, where he has lately been working on problems of food technology and on South African seaweeds as sources of agar. He directs attention to the acute need in South Africa for basic research on marine problems and to the extreme shortage of laboratories and staff, giving excellent summaries under various headings: the fundamental cycle of life in the sea, knowledge of plankton basic to the fisheries, a brief history of fisheries research in the Union, our knowledge of chemistry and physics and of the marine biology of South African seas, certain general considerations arising out of the review of fisheries and marine biological investigations in South Africa, and, finally, a project for a marine research institute with special reference to plankton.

Marine products are among the least exploited of the Union's resources, although the fauna is a vastly rich one and there is abundance of fish. In 1934 the Board of Trade reported that the annual consumption of fish in the Union is only 4½ lb. per head of the population, and, later, C. von Bonde and Rees Davis directed attention (1942) to the small fish consumption. The corresponding values for Britain and Norway are 41 lb. and 70 lb. respectively. A sound knowledge of the marine biology and hydrology of the regions concerned is imperative, and at present only the fringe of such studies has been approached.

The project for a research institute with special reference to plankton is a good one, including as it does suggestions for special work at first conducted from one central research institution, later spreading to several marine stations with their full number of boats. It is urged that such a marine research

* Marine Biological Research and the South African Fishing Industry. By Wm. Edwyn Isaac. Research Memorandum I, 1943. Published for the Association of Scientific Workers of Southern Africa (Cape Town Branch) by the African Bookman, P.O. Box 3115, Cape Town. 1s. 6d.

institute should be concerned only with fundamental research, and although keeping in close touch with the fisheries should be freed from the routine of fisheries work. Although the desirability of a marine research institution is discussed more particularly in relation to plankton work, the author states that it is obvious that it would concern itself with all the fundamental aspects of marine biology. Work on the life-histories of the most important fishes is clearly one of fundamental significance, and it is to be hoped that it would occupy a large place in the planning of the work in the marine institute.

Sites for the central laboratory and for three sub-stations are suggested. All these plans should not be too difficult to carry out in the near future, and although admittedly a background of fundamental knowledge can only be acquired by long years of patient work, the sooner this is begun the better. With such an unexplored field it is hopefully maintained that results of practical significance might emerge soon.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, October 30

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Royal Society, Burlington House, Piccadilly, London, W.1).—Centenary Meeting.

At 11.15 a.m.—Sir John L. Myres: "A Century of Our Work".

At 3 p.m. (at 21 Bedford Square, London, W.C.1).—"The Future of Anthropology". (Dr. G. M. Morant: Physical Anthropology; Prof. V. G. Childe: Archæology: Mr. R. U. Sayce: Material Culture; Dr. R. Firth: Social Anthropology).

Monday, November 1

BRITISH SOCIAL HYGIENE COUNCIL (in the Hastings Hall, B.M.A. House, Tavistock Square, London, W.C.1), at 3.30 p.m.—Sir Walter Langdon-Brown: "Social Biology and Planning".

ROYAL INSTITUTE OF CHEMISTRY (YORKSHIRE SECTION) (joint meeting with the LEEDS UNIVERSITY CHEMICAL SOCIETY) (in the Chemistry Lecture Theatre, The University, Leeds), at 6.30 p.m.—Dr. A. D. Mitchell: "Demonstration of Improved Methods in Volumetric Analysis".

Tuesday, November 2

SOCIETY OF CHEMICAL INDUSTRY (PLASTICS GROUP) (joint meeting with the INSTITUTE OF PLASTICS INDUSTRY and the INSTITUTION OF RUBBER INDUSTRY) (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2 p.m.—Symposium on "Rubber-like Plastics and their Applications".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Progress in the Treatment of Infections", 1: "Assisting Nature's Reactions".*

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield 1), at 6.30 p.m.—Discussion on "Hardenability" (to be opened by Mr. T. F. Russell, Dr. R. J. Sarjant and Dr. W. Steven).

Wednesday, November 3

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. F. Armstrong, F.R.S.: "The Long Road of Progress".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Scientific Papers.

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. J. Kemp: "Wave Guides in Electrical Communication".

Thursday, November 4

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "The Methods of Modern Astronomy", 1: "Spectroscopic Astronomy".*

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (joint meeting with the ASSOCIATION OF AUSTRIAN DOCTORS) (at Austria House, 28 Bryanston Square, London, W.1), at 7.15 p.m.—Dr. F. Scholl: "Chemotherapie im lichte neuer Forschungen—Sulphonamide und Penicillin".

Friday, November 5

NATIONAL SMOKE ABATEMENT SOCIETY (at Caxton Hall, Westminster, London, S.W.1), at 10 a.m.—Conference on "Measures for the Prevention of Smoke in relation to Plans for Post-War Reconstruction".

SOCIETY OF CHEMICAL INDUSTRY (YORKSHIRE SECTION) (at the Queen's Hotel, Leeds), at 3.30 p.m.—Dr. Wm. Cullen: The First Brotherton Memorial Lecture.

PHYSICAL SOCIETY (in the Physics Department of the Imperial College, Imperial Institute Road, South Kensington, London, S.W.7), at 4.30 p.m.—Dr. Bruce Chalmers: "The Non-destructive Testing of Metallic Components."

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. A. O. Rankine, F.R.S.: "The Dispersal of Fog".

Saturday, November 6

NUTRITION SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1).—Conference on "Post-War Nutritional Relief".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING—The Principal, Technical College, Brunswick Road, Gloucester (November 4).

BOROUGH ELECTRICAL ENGINEER AND MANAGER—The Town Clerk, Town Hall, Leigh, Lancs. (endorsed 'Borough Electrical Engineer and Manager') (November 4).

CULTIVATIONS OFFICER to the Isle of Wight War Agricultural Executive Committee—The Executive Officer, Lugley House, Lugley Street, Newport, Isle of Wight (November 6).

SPECIALIST TEACHER FOR THE REMEDIAL TREATMENT OF STAMMERING—The Director of Education, Education Offices, Burnley (November 6).

TEACHER OF MECHANICAL ENGINEERING SUBJECTS—The Principal, Luton Technical College, Park Square, Luton (November 9).

BOROUGH ENGINEER AND SURVEYOR AND WATER ENGINEER—The Town Clerk, Town Clerk's Office, Brook House, Dover (endorsed 'Borough Surveyor') (November 15).

HEAD OF THE ELECTRICAL ENGINEERING DEPARTMENT—The Secretary, Robert Gordon's Technical College, Aberdeen (November 20).

FOREST ENGINEER, and an ASSISTANT FOREST ENGINEER (must be good mechanical engineers with experience in sawmilling, steam engines and mechanical logging operations), for the Sierra Leone Forestry Department—The Secretary, Overseas Manpower Committee (Reference No. 1114), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

TEACHER OF MATHEMATICS AND MECHANICS—The Principal, Erith Technical College and Day Technical School, Belvedere, Kent.

MECHANICAL AND ELECTRICAL ENGINEERS (2) with (a) ability to stimulate and supervise local production in ferro-alloys, carbide detinning, electrodes, etc., and be familiar with metallurgical work, and (b) conversant with foundry and metal work and construction—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1910A).

FIRST ASSISTANT ENGINEER (Reference No. E.776), and a SECOND ASSISTANT ENGINEER (Reference No. E.777)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scottish Society for Research in Plant-Breeding. Report (abridged) by the Directors and Report by the Director of Research to the Annual General Meeting, 15th July 1943. Pp. 34. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [229

Edinburgh and East of Scotland College of Agriculture. Calendar for 1943–1944. Pp. 62. (Edinburgh: Edinburgh and East of Scotland College of Agriculture.) [240

A Glossary of Terms used in Sex Hormone Therapy. (Reprinted from the *Pharmaceutical Journal*.) Pp. 20. (London: Pharmaceutical Press.) 1s. [279

National Central Library. 26th and 27th Annual Reports of the Executive Committee, 1941–42 and 1942–43. Pp. 24. (London: National Central Library.) [279

Other Countries

Smithsonian Miscellaneous Collections. Vol. 104, No. 1: The Feeding Apparatus of Biting and Disease-Carrying Flies; a Wartime Contribution to Medical Entomology. By R. E. Snodgrass. (Publication 3732.) Pp. ii+51. (Washington, D.C.: Smithsonian Institution.) [109

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ended June 30, 1941. (Publication 3651.) Pp. xiii+596+121 plates. (Washington, D.C.: Government Printing Office.) 2 dollars. [209

Newfoundland Government. Research Bulletin No. 12: Salmon Investigations, 1: Obstructions in Newfoundland and Labrador Rivers. By A. A. Blair. Pp. 50. (St. John's, Newfoundland: Department of Natural Resources.) [219

Arkiv för Zoologi utgivet av K. Svenska Vetenskapsakademien. Band 34A, No. 13: Entomological Results from the Swedish Expedition 1934 to Burma and British India. Lepidoptera: Drepanidæ Meyrick, gesammelt von René Malaise. Von Felix Bryk. Pp. 30+3 plates. Band 34A, No. 20: Further Contributions towards the Comparative Morphology of the Mesostigmata (Acarina), 6: The Antennephoridæ and the Megisthanidæ. By Ivar Trägårdh. Pp. 10. (Stockholm: Almquist and Wiksell.) [219